Eng. Lib.

COMPRESSED AIR MAGAZINE

DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. XVI JULY, 1911 No. 7

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Classified Buyers' Guide, Page 12. Index to Advertisers, Page 8.

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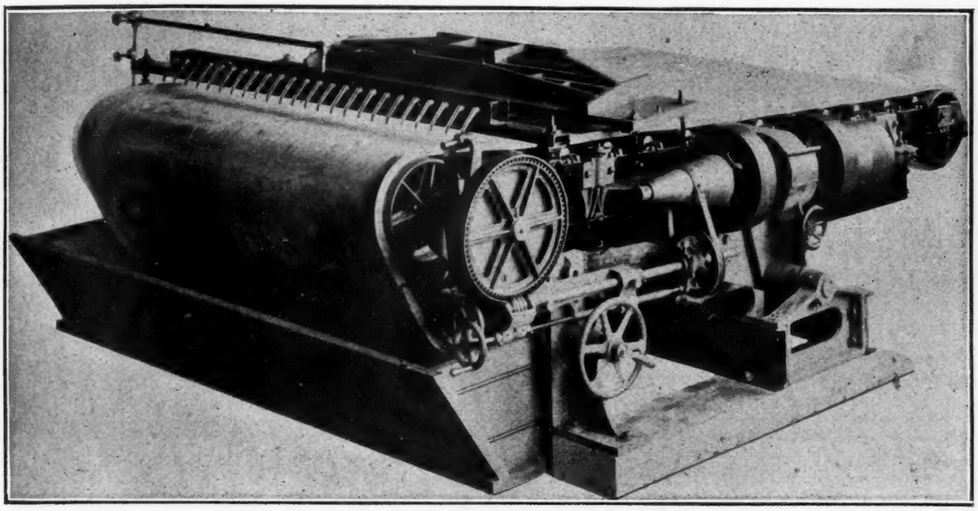

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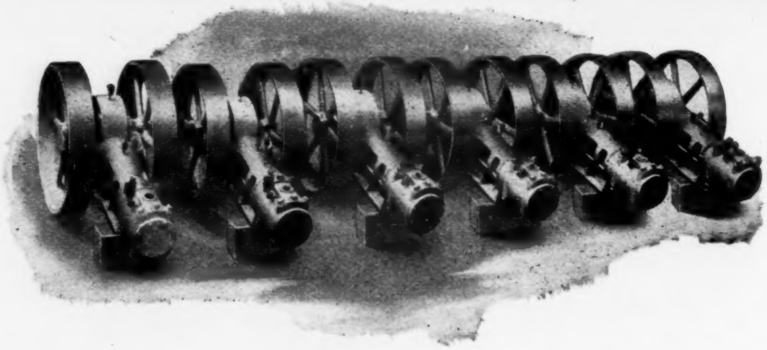

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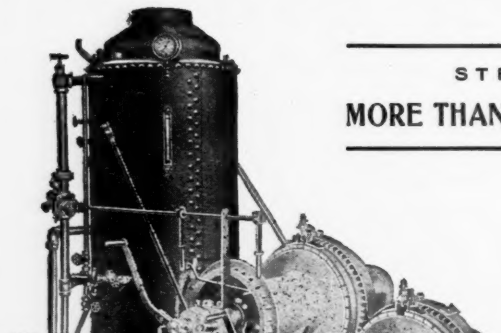

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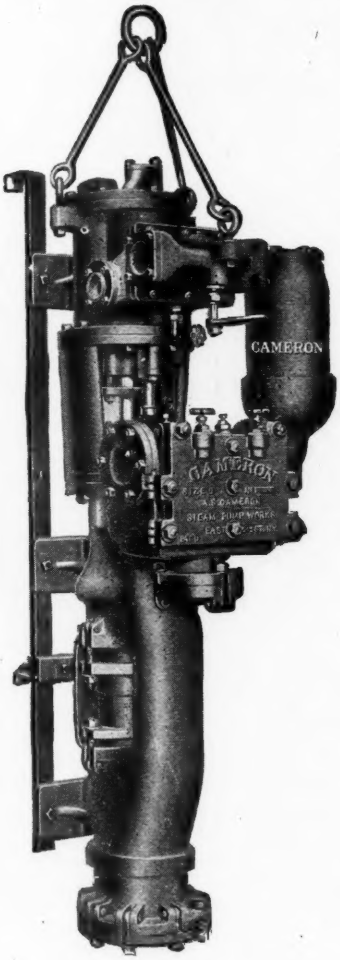

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INDEX TO ADVERTISERS.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XV JULY, 1911 No. 7

BY WHAT RIGHT?

BY FRANK RICHARDS.

The title of this article being a simple question, it is intended to so far correctly characterize what follows, as the attitude of the writer is interrogatory rather than assertive, and it is not much that he wants answered. It is expected that it will appear to be high time for some one to be shaping and putting the question here crudely suggested.

The simple question is as to the permissible retention of the ancient methods of gas storage and distribution, with special reference to the protuberant gas-holder, and this from the view-point of neither the gas producer nor the gas consumer, as such, but of the general and long-suffering public.

Gas, of course, is an established necessity to practically all the people, and all questions as to cost of production and distribution, quality of gas furnished and convenience and reliability of service are to be settled between producer and consumer, with or without the aid of legal enactments, and no one else so far is interested.

It happens, however, that the method of storing and distributing the gas cannot be indifferent to the otherwise disinterested public, for it touches all at more than one sensitive point, and in an objectionable way which should not be tolerated or permitted, except in so far as it may be unavoidable. We have been so familiar for so many years with the sight of the supreme uglifier in every large outlook in every city in the land that we do not realize the unsightliness of it; we do not think to protest against it, or, in fact, in any way to question its presence. Who has thought of asking by what right the gas-holder intrudes, or has suggested its expulsion if its necessity and right are not proven and upheld?

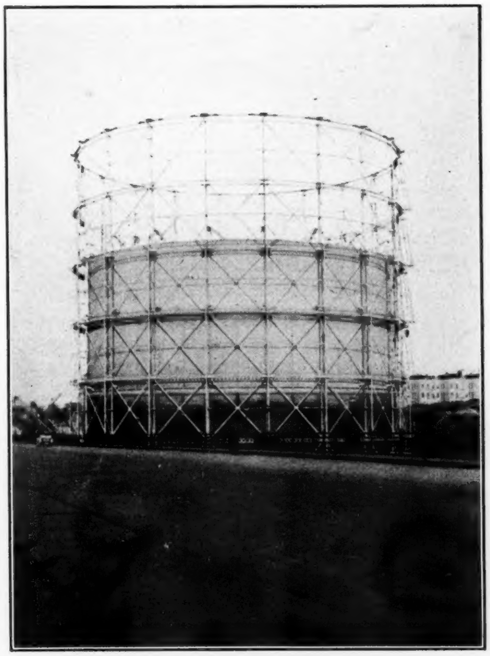


FIG. 1. BY WHAT RIGHT?

The question is so far from ever having been formulated that the gas-holder has never treated the public as in any way entitled to an explanation or a justification wherever and whenever it has chosen to plant itself. It has no doubt at times had to establish certain legal rights to locate, but always upon the unquestioningly conceded assumption of the imperative necessity of it. Is it so necessary and indispensable? If so, it should be "up to" the gas people to prove it in the light of the pres-

ent century. When it came to proving the necessity of the telegraph poles they quickly fled the city streets.

Few realize how bad the case is, or, indeed, have given the matter any thought at all, and it would seem to be an opportune time to stir things up. Civic pride is becoming alert and restive. We are beginning to take an interest in the appearance and condition of our cities, and many movements are on foot for their betterment. But what shall we do with the gas-holder? Think of the costly viaduct starting from Grant's Tomb, in New York, and connecting to the upper stretch of the beautiful Riverside Drive all completed, and then almost immediately the popping up of the afreet we see in Fig. 1. No one objected or thought of protesting at the time or since, as far as we have heard, because it is a gas-holder, you know.

The work of redesigning, rearranging and permanently beautifying our cities, of rendering them more satisfactorily habitable, so that not only we, the indwellers, but also the incomer and the transient onlooker, shall say it is good to be here, cannot proceed far before we realize that much of our doing must first of all be undoing. We cannot rearrange and upbuild to our liking until we tear down, banish or obliterate the things which, if undisturbed, would render our efforts futile. Objectionable and, but for our familiarity with them, often disgusting features have accumulated and established themselves unchallenged, and yet if they are allowed to remain there can be no real progress toward permanent and satisfactory improvement.

In Fig. 2 we are looking up West End Avenue, New York, a beautiful and high-class residence street which retains its select character all the way up to the end of it, two or three miles to the north. In Fig. 3 we are still looking up West End Avenue, but from a point just a quarter of a mile further down. From the same point, turning to the right, we have Fig. 4, a row of well-built tenements, but only colored people can be found to occupy them. Fig. 5 was their outlook a year or so ago. Since then these unimproved lots, there being apparently no prospect of erecting respectable, substantial, permanent buildings upon them, have mostly been covered with cheap and shabby sheds for storing carts, etc., which city ordinances do not permit to stand in the street at night. Directly opposite these lots, on the other side of West End Avenue, are the primitive rocks of Manhattan, with squatter shanties surmounting them, neither of which, shanties or rocks, it has been worth while to remove. The next block to the north on the same side of the avenue is a lot, without buildings, in which castings and steel work are stored.

Farther away in all directions, for, say, three or four blocks all around these gas-holders, they have been the means of accomplishing, as some might say, a work of great beneficence by so depreciating the property values as to make possible the erection all through the neighborhood of tenements of the cheapest class for the occupation of the minimum wage-earners and of the strugglers for precarious subsistence. If it were not for the blessed gas-holders where would these poor people go?

This is not in the outskirts of the city, but in the heart of it, the location being in the Sixties, while the island is solidly built up for more than a hundred blocks above. There is everything to warrant the presumption that all this section of the city, of which this one group of gas-holders is the center, would be very differently occupied and improved if the gas-holders were not there. Certainly it would all be well and profitably used, which it is not now, and the location, otherwise desirable and easily accessible, deserves a better fate.

We could get pictures of similar character to those here presented from each of the dozen or so of gas-holder neighborhoods of Manhattan, and the same of every other large city, showing them all to be nuclei of desolation and responsible for the depreciation of property values amounting in the aggregate to hundreds of millions of dollars. It is not for the present writer to estimate the amount of this depreciation, but it would be well for real estate experts to be doing some figuring upon the problem.

Suppose that some day there should come to some one the assurance in advance that the gas-holders in the cities would all have to go (and the gas companies are likely to be themselves the first to realize it), what an attractive and promising speculation it would be to quietly buy up all the depreciated property in these gas-blighted neighborhoods.

The gas-holder is simply to-day the survival

FIG. 2 LOOKING UP WEST END AVENUE.

of the unfit, if not cf the unfittest, and it seems more tenacious of life than any other thing of which we have record. Nothing can be more certain than that if the gas business were beginning as a new business to-day it would not begin with the absurdly low-pressure service now in use, but it began in that way a hundred years ago and has not changed.

"Little of all we value here
Wakes on the morn of its hundredth year
Without both feeling and looking queer,"

and low pressure gas is queer enough. Just think of it. Ordinary city gas is transmitted and stored and distributed at pressures so minute as not to be measurable in pounds to the square inch, as we commonly measure and record pressures, nor even in ounces, but in tenths of an inch of water.

We happen to have conveniently at hand the figures from a typical city plant. At Syracuse, N. Y., they have about 170 miles of gas mains, from 2 in. to 20 in. in diameter, and the gas

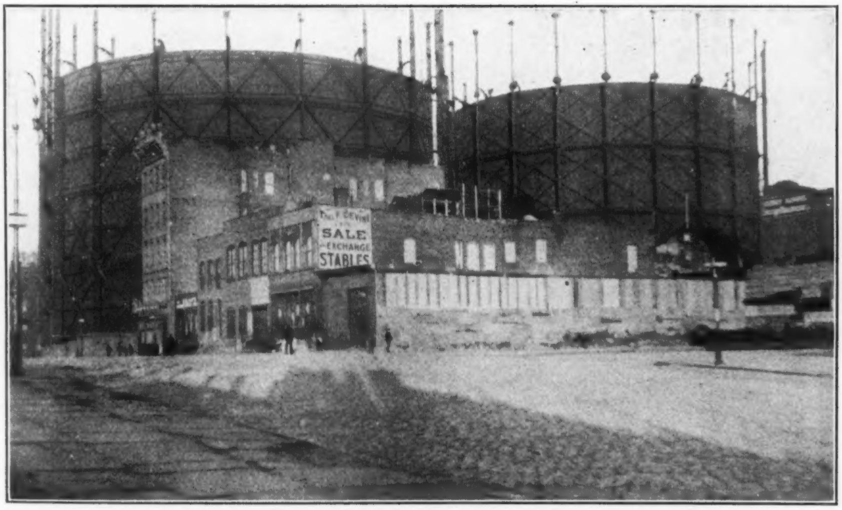


FIG. 3. LOOKING UP WEST END AVENUE.

pressure varies from 1½ in. to 3½ in. of water, these being the limits, or, say, 1-20 to ⅛ lb. to the square inch. In the literature of the gas men the maximum pressure here mentioned is spoken of in the record as 37 tenths of an inch of water. Why, a boy with a tin bean blower could give you double that pressure. A familiar boy's trick is to blow into a burner against the pressure, filling the pipes with air and putting out the lights.

And yet the existence of the gas-holder is absolutely conditional upon the retention of these low pressures, these pressures of a hundred years ago, in storage and in distribution. Any, even a slight, increase of pressure would be death to the gas-holder at once. Take any one of the largest gas-holders, such, for instance, as the one first shown here, and an increase of 1 lb. in the pressure within it would require an addition to the weight on the top of about 2,000 tons. This would give a steel top over 3 in. thick, an effective armor against aeroplane bombs.

It would, in fact, be impossible, for another reason, to carry an additional pound of pressure in the gas-holder, even if it could be weighted down sufficiently. In all candor and seriousness, the modern gas-holder is a magnificent achievement in engineering, and one of the wonders of it is the telescoping feature. When the holder is full and has risen to the top of its guides it is not, as it looks, a single shell, but consists of four or five "lifts," which slide into each other as they descend. To make a gas-tight joint between the lifts there is to each a "water seal" which retains the gas with absolute security, as long as it holds it at all, but if the gas pressure were increased to ½ lb. to the sq. in., or about that, instead of ⅛ lb., the present maximum, the water would all be blown out of the "seals" and the gas would escape as fast as it flowed in.

It is, of course, familiar to everyone that the rate of gas consumption varies throughout the entire 24 hours, what is called the "peak" load coming between sundown and midnight, with a smaller peak in the morning. When the peak is on the consumption is, of course, several times as great as, for instance, in the small hours when the day is young, and a pipe transmission which would be sufficient if it could be continued uniformly all day and all night is altogether unable to maintain the supply when the demand is greatest.

It is said, therefore, and this is the special excuse for the added monstrosities of recent years, that we must have the big gas-holders to take care of the peak load. Certainly, if we retain both the low-pressure transmission and the low-pressure distribution. With the 2 or 3 in. of water pressure the gas cannot be rushed through the pipes. With a pressure increased to only 15 lb. to the sq. in. the volume of the gas would be reduced one-half, and it could be driven along at more than four times the present speed, so that pipes of the same size as now in use would transmit eight times the quantity of gas, or as much in three hours as can now be sent through in the 24 hours. This surely would be at a speed sufficient to take care of the peak load, and supply all consumers at all times without the waiting in gas-holders by the way. In this way we have at once a suggestion for the beginning of reform by the warrant it gives for first of all insisting that no additional gas-holders shall be erected anywhere for taking care of peak loads. We have already a long list of locations where gas is transmitted at high pressures to reinforce existing low-pressure storage systems and avoid the necessity of increased holder capacity.

A Mr. Jones, before the Pacific Gas Association, is thus reported: "One of the ambitions of my life is about to be realized in the construction of a steel bracelet around the city of San Francisco for feeding the low-pressure system. This main is now in the ground and is 16 in. in diameter and 7½ miles long. It extends from the old Portrero Gas Works around the city to the old plant we call the North Beach Station. The line is not yet in use for conveying gas, on account of construction work now going on, but it has been under 60 lb. pressure for over 30 days, and has maintained a constant pressure at uniform temperatures both day and night." The piping was entirely successful for the purpose intended, and the preliminary test gave full assurance that there would be no leakage.

What we are certainly coming to is the entire abolition of the hundred-year-old gas pressures, with the gas-holders which cannot survive them, and the service of gas at so-called high pressures—although they would not be high as compared with steam and compressed air pressures—directly to every consumer. The following from the "Gas World" (Feb 4, 1911), an English publication, is reprinted with approval by the "Progressive Age" (March 1,

FIG. 4 APARTMENTS FACING THE GAS HOLDERS.

1911), an able representative of American gas interests. As will be noticed, it goes far beyond the suggestions of the present writer. The article referred to says:

"The introduction of high-pressure gas, when thoroughly understood, will do more for the industry than ever the incandescent mantle did. Its potentialities—its far-reaching utilities—are beyond all power of description.

"All great changes take place gradually, and it is not to be expected that the change from low to high-pressure gas will be any exception to the rule. Engineers will not jump from 2 in. of water to 200 lb. to the square inch, and yet this is the jump which modern improvements enable any man to take who seriously looks into the question and who realizes what is at his disposal to carry it out.

"With regard to experience, we have at our disposal the record of railway carriage lighting by compressed gas up to 150 lb. or more. In America gas has been distributed at 200 lb. In this country (England) gas has already been distributed at 100 lb., and several miles of mains will be in actual use before many weeks."

FIG. 5. OUTLOOK FROM APARTMENTS ABOVE;

The article quoted then goes on to consider the different distribution of costs under the new system, which we need not go into here. Although the high pressures it refers to are all matters of actual record, and in natural gas transmission the pressures go much higher, it would be sufficient for our present purpose to have only 15 lb. per square inch as a maximum working pressure. This would surely render the gas-holders worthless, and if sufficient pressure were put upon the outside of them by the awakened public they would collapse and disappear, property values would reassert themselves over the desolated city areas, and there would be renewed hope for other reforms to follow.

The gas-holder, it may be suggested, is in a way like our bad spelling, as some call it; our bizarre weights and measures, as the metricists insist; our Fahrenheit thermometer; our decimal, instead of duodecimal, notation: a thing which started wrong, but which has now become so established that change is not to be thought of. In this case a change insists upon being thought of.

It is not necessary to remind anyone that no gas-holders of the gravity pressure type are used, or could be used, in the distribution of natural gas, so that they cannot be imperative for artificial gas. As we have seen, they at once become impossible with any increase of pressure; yet gas consumers are requiring higher pressures. The obsolescent fish-tail burner was satisfied with a pressure of 1½ in. of water; the incandescent mantle gives much more light for gas consumed, but it demands higher pressures. Higher pressures are called for where gas is used for heating purposes and much higher pressures are required for gas engines. Gas should be brought to each consumer at a pressure high enough to require a regulator, and this could be individually adjusted to any pressure required, so that everyone could be using it at its best, according to the use to which it was applied.—*Engineering Record.*

There is a grotto at Pozzuelo, near Naples, into which a man can walk without injury, but in the atmosphere of which a dog becomes immediately asphyxiated. The heavy gas emitted from the soil lies near the surface; the man escapes it, but the dog inhales it with deadly effects.

NITROGEN-FIXING BACTERIA

By E. S. Mather.

Scientists and bacteriologists in various parts of the world have been for many years interested in discovering new methods of producing nitrates, to replace the rapidly diminishing supply and insure the world against gradual starvation. Without nitrates, the plants on which we depend for our food supplies, cannot live.

Three principal elements required by plants are phosphoric acid, potash and nitrates. The first two exist in rocky particles in the soil, and there is no immediate danger of their becoming exhausted. For our supply of nitrates, in the form of nitrate of soda, we are obliged to rely on the saltpetre deposits in Chili, and so great is the demand for this material that the most available portions have already been used up, and the rapidly increasing cost of production will soon place what little remains beyond the reach of the agricultural world.

Much has been said about a new electrical process, by which atmospheric nitrogen is changed into nitrate of lime. This is exceedingly interesting, and of great value, but to depend on such a source, to supply the enormous quantity of nitrates needed for agricultural purposes, is entirely out of the question, and the cost would be prohibitive for such purposes. Homeopathic doses of nitrogen will not raise big crops of corn and wheat.

Let us turn, therefore, from these most interesting manufacturing phenomena, and consider the wise provision that nature has made for just this emergency, namely, the fixation of nitrogen by bacteria, through the medium of legume crops. For in this method lies the solution of the problem, and the next generation will marvel at the folly of their fathers in expending large sums of money for material that could be abundantly supplied almost for the asking.

The discovery of the value of treating the seeds of legume crops with nitrogen fixing bacteria, as a means of enriching the soil in nitrates, is not new, but, like many great discoveries, its general practice has been greatly retarded by crude methods, and premature exploitation, which has prejudiced the minds, not only of farmers, but of the very men in the agricultural experiment stations and colleges, to whom the farmer turns for advice.

The necessity of inoculation is well recog-

nized by the best authorities to-day, but recognition of the advantage of using pure cultures of high-bred bacteria for this work is apparently retarded by the suspicion of commercial cultures and lack of knowledge of the methods employed in their production, and we find many college men advising the farmer to get inoculation for his crops by the crude and expensive method of teaming large quantities of soil from any old field, where the legume they wish to plant has been grown, then distribute the material over the field he intends to plant, and relying on the chance inoculation of wornout and attenuated organisms, with the added advantage of a fresh supply of weeds and soil diseases that have been transferred at the same time, rather than to place high-bred active cultures of the bacteria on every seed that is to be planted, ready to furnish nitrates the minute the seed has germinated.

Exhaustive experiments have shown that legume bacteria existing in the soil often become debilitated and gradually change their habits, losing their power of taking nitrogen from the air and living on the nitrates that are in the soil. They sometimes even become parasitic on the plants.

When the bacteria have been grown in a nonnitrogenous medium directly on the roots of the same kind of plants they are to be used for, their potency is greatly increased, and all the attendant dangers of the soil transfer method are done away with.

The many failures to secure results from inoculation of seeds were largely due to three causes: First, to lack of attention to the great importance of breeding the organisms to secure the strongest and most virile specimens. Second, to crude methods of sending them to the user, and keeping them alive until they could be put on the seeds. Third, to lack of knowledge of necessary soil conditions for their proper development.

These difficulties have been overcome by Dr. G. H. Earp-Thomas, and he is sending to farmers, from his laboratory, in Bloomfield, N. J., cultures of high-bred bacteria, that are guaranteed to keep in perfect condition for long periods of time, and require no further development on the part of the user. The bacteria are simply put on the seed, and nature takes care of the rest. In selecting bacteria for breeding purposes, it is, of course, necessary to watch the development of the different colonies on the roots of the legumes, and it would be manifestly impossible, when working with plants (under ordinary conditions), to pull them up every day to examine them. It was the discovery of a transparent jelly, so delicately balanced that it would furnish a perfect plant food, that has made this work possible. This jelly containes no nitrates except those produced by the bacteria on the growing roots.

Furthermore, no bacteria other than the legume bacteria can grow in this jelly, and it not only makes a perfect method of selecting pure cultures, but its transparent jelly enables the bacteriologist to watch the development of the nodules or colonies of the roots and thus select the bacteria that are most active. By this process of selection and the repeated inoculation of fresh plants grown in the same manner, cultures are produced that have much greater power of fixing nitrates than those usually found in the soil.

Experiments carried on by one of the State Experiment Stations proved that these high-bred cultures would produce from one to four hundred per cent. more nitrates than those usually found in the soil. It is also true that the increased activity of the bacteria means quicker production of nitrates and ample supplies of this most essential material during the early stages of the growth of the plant.

Every form of vegetable life can be improved by proper methods of selection and breeding, and it was the realization of this well-known principle that led to this important phase of Dr. Earp-Thomas' work, and his subsequent discoveries.

Having procured the means of breeding pure active cultures it became necessary to devise some means of preserving them, until such time as they could be used. The earlier attempts of the United States Department of Agriculture, and other people to send the bacteria to the farmer, dried in cotton, had not proved successful, and the bacteria when sent in a liquid preparation in sealed bottles, soon lost their vitality from lack of atmospheric nitrogen.

Were it possible to keep bacteria in good condition in a liquid medium there would still be strong objection to this method, as it is impossible in such preparations to detect the presence of moulds and other contaminations that are dangerous to the nitrogen fixing bac-

teria. The value of all cultures of bacteria depends very largely on their purity and freedoom from contamination. Dr. Earp-Thomas' method of growing cultures on the surface of the jelly in the bottles in which they are sent to the user enables him to easily detect such imperfections and prevent their distribution.

The invention of a bottle stopper which admits a supply of air through a glass tube containing cotton filter plugs, that keeps out contaminations, yet it is so constructed as to prevent the escape or evaporation of the contents of the bottle, is not simply an ingenious device, but a remarkable contribution to the art of preserving bacteria and protecting the cultures from destructive elements. The development of these methods and processes means that another of Nature's forces has been harnessed for the benefit of mankind, and the question of maintaining the supply of nitrates in the soil is finally solved.

To secure the best results from the use of nitrogen fixing bacteria, some consideration must be given to the conditions of soil that are most favorable to their growth, and the most important is the question whether the land is acid or alkaline.

The development in the land of beneficial soil bacteria of various kinds is to a great extent dependent on proper chemical conditions. Microscopic examination of soil and the determination of the kinds of bacteria that are found therein, will tell the story of its fertility more surely than chemical analysis, as the presence of some form of bacteria is a sure sign of its productiveness, whereas other kinds indicate improper conditions that must be corrected if good results are to follow. It has been found that highly productive land contains large quantities of beneficial bacteria, whereas poor soil is deficient in this respect, but often contains large quantities of organisms that are known to be injurious in their effect on plant life, and destructive to the nitrogen fixing bacteria. The protozoa, and the various forms of fungi yeasts and anacrobes belong to this class. Science has not yet determined the practical means of exterminating all of these forms, but much has been learned about conditions that are favorable to the nitrogen fixing bacteria, and this knowledge is available to every farmer. Good drainage and cultivation are well known requisites for good farming, but the beneficial effect of lime may not be so well understood. Bacteria cannot fix nitrogen in the soil without some base with which it can be combined, and lime is by far the cheapest material that nature has provided for this purpose. Lime also has strong chemical action, and neutralizes the acid conditions of the soil. Land that is acid or sour is fatal to the growth of the nitrogen fixing bacteria, and the corrective use of lime is most valuable. The use of green manures and fertilizers makes the application of lime absolutely essential. Heavy soils require more than light soils.

Loss of nitrogen in the soil is often the result of denitrifying bacteria which exist in heavy wet soils and decaying organic matter. Such conditions can be prevented by proper drainage and the application of lime to lighten the soil, and put it in proper condition for the growth of legume crops that have been inoculated with pure cultures of high-bred bacteria.—*N. W. Farm and Home.*

DESICCATION AIR BY CALCIUM CHLORIDE*

This method of drying the air for blast furnaces has been put into operation at Differdange. The process is as follows:—

A layer of broken calcium chloride, the smaller pieces at the bottom and the larger pieces at the top, rests on a sieve. Within the mass of the calcium chloride and in its lower part is submerged a spiral grating consisting of pipes for the circulation of water. The air to be dried is drawn downwards through the calcium chloride by a fan. The heat evolved by the action of the water on the lime is carried away by the water within the spiral. When the outside pellicle of the broken pieces commences to liquate hydration is stopped and regeneration begun. To do this it is only necessary to attain temperatures between 175 deg. and 235 deg., at which $CaCl_2 + 1\ H_2O$ is formed. It is necessary gradually to raise the temperature in such a manner as constantly to maintain the hydrates in their solid phase.

It is necessary also in the course of this regeneration to be careful not to exceed the temperature of 235 deg., above which the "tardy" hydrate $CaCl_2 + 1\ H_2O$, is formed.

*From a paper before the Iron and Steel Institute of Great Britain, by Felix A. Daubine and Eugene V. Roy, Aubone, France.

It may be seen from the foregoing that it is possible to effect the regeneration of the calcium chloride with sources of heat of comparatively low grade, and that it is possible to employ with this object the waste fumes which occur plentifully in all metallurgical works.

The regeneration of the calcium chloride having been effected by this systematic warming, it is necessary in order to render it again fit for the complete absorption of water vapour to cool it thoroughly. This cooling is quickly attained by a rapid circulation of water in the pipe system. When the temperature has returned to that of the average environment the chloride of calcium has regained all its hygroscopic properties, and is capable of dessiccating afresh the new volumes of air.

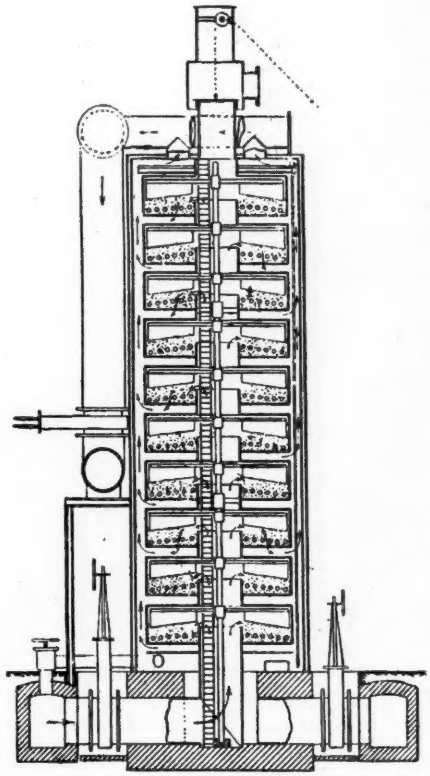
A mass of calcium chloride of 240 kilos. spread out in a layer of 24 cm. in depth, on a square metre of surface, will desiccate 300 cubic metres of air per hour, for four hours, under average conditions of 15 grammes of moisture per cubic metre.

In order to regenerate the calcium chloride from its hygrates, calculation shows that it is necessary to expend about 7.500 calories per kilogramme of water deposited. In practice it suffices to circulate from below upwards—that is, in the opposite direction to the air current—warm air or fumes devoid of dust at gradually increasing temperatures from about 30 deg. to 200 deg. during a period equal to half the length of time of the passage of the air current—that is, for the example given above, for two hours.

Experiment has shown that it is possible in a well-watched and carefully-conducted operation to attain a degree of desiccation such that the hygrometric condition of the desiccated air will be for the average period of passage but 10 to 15 per cent. of its saturation at a temperature of 15 deg.

The problem at the Differdange Works was to desiccate the whole of the air required for the blowing of a blast furnace of 150 tons per twenty-four hours. In the design shown in the cut the blast is introduced by a central well, and distributed in layers by means of the openings leading to different superposed reservoirs. On emerging from the latter it is collected in an annular chamber, whence it is led to the place where it is to be utilized.

In order to be able to regenerate the chloride of calcium on the spot, the central well—or



CALCIUM CHLORIDE AIR DRYER.

the annular chamber—is connected with a second pipe, admitting air or hot gases. The arrangement of the fans is such that it is possible, at will, either to pass the air to be dried, or the gases which are to serve for the regeneration, through the apparatus, or else to isolate it completely during the cooling down. The apparatus, which is in triplicate, dries 30,000 cubic metres of air hourly, and has the following proportions:—Total area presented to the passage of the blast, 100 square metres per apparatus; number of compartments, ten; depth of layer of calcium chloride in each compartment, 24 cm.; apparent density of the chloride of calcium, 1.0; weight of chloride of calcium contained in each apparatus, 24,000 kilos.; weight of chloride of calcium contained in all three appliances, 72,000 kilos.; cooling surface of the spirals in each apparatus, 170 square metres. These appliances have been designed to work in the most unfavorable conditions—that is to say, to remove, during the summer months, 15 grammes of moisture

per cubic metre of air during a period of four hours.

At the time of writing this paper the appliances have been working normally for six weeks; but as the season is the end of winter, and as the moisture in the air is not very large, it has been found unnecessary to make as many reversals as were contemplated. Each apparatus receives the blast for six to eight hours. The air, which contains 6 to 8 grammes of moisture before its passage, only contains from 1 to 1.5 gramme per cubic metre on emerging from the apparatus, and this figure remains practically constant from the commencement to the conclusion of the period. Regeneration requires four hours for its completion, and is carried out by means of the waste smoke gases from boilers and from Cowper stoves. These gases, cleaned to the extent of 0.4 gramme per cubic metre, pass directly through the mass of chloride. The temperature is regulated at 30 deg. to commence with, and thereafter gradually raised in conformity with a certain ascertained law up to about 200 deg. In the summer the temperature will be carried to 275 deg. Cooling takes three hours.

The installation has cost a little less than one-quarter of what would have been the cost of an installation for desiccation by means of refrigerating machines. One man for the day shift and one for the night shift are sufficient to handle the apparatus, which is of the most simple description. The expenses of working are thus greatly reduced.

THE INTERCOOLER IN STAGE COMPRESSION

The following article by J. William Jones, Painted Post, N. Y., is reproduced (with some condensation) from the June, 1911, issue of *Machinery*.

In compressing air to 100 pounds gage pressure, the final temperature, assuming the compression to be adiabatic, would be about 485 degrees F. The effect of this increase in temperature is to expand the air under compression to a larger volume, thus necessitating a corresponding increase of work to compress it. After the compressed air has been discharged into the receiver or pipe line the temperature rapidly falls to that of the surrounding atmosphere, and the energy due to the heat generated during compression is lost. In theory, the air should be kept at a constant temperature during the period of compression; but the attainment of this is a practical impossibility in compressors of the present day.

In modern compressor practice, the work is divided between two or more stages, the number of stages depending on the final pressure required, and the employment of an "intercooler" between the different stages to reduce the temperature of the compressed air to the normal between the stages. In effect, this arrangement is equivalent to doing all the work in a single cylinder if it were possible to stop the piston at a certain point of the stroke, reduce the temperature of the air already partially compressed to that of the surrounding atmosphere, at the same time moving the piston forward just fast enough to keep the pressure constant, and then starting the piston again and continuing the compression to the desired pressure.

A sectional view of an intercooler built in accordance with modern practice is shown in Fig. 1. This intercooler consists of a long shell of cylindrical shape containing a nest of tubes through which cold water is circulated. The air enters at one end of the shell from the low-pressure cylinder at a high temperature, passes around and between the nest of tubes and enters the high-pressure cylinder at the other end at a greatly reduced temperature. This cooler is usually placed immediately above or below the cylinders in order to secure the shortest connections possible, the air remaining in these connections being denied the cooling effect of either the cooler nest or the water jackets of the cylinders.

As the intercooler is primarily the medium through which the saving in power is to be derived, it is obvious that unless proper attention is given to all its details the desired effect may not be realized. The essential points to be considered in the design of an intercooler are: Cooling surface, efficient water circulation, volume of cooler, proper deflection of the air around and between the tubes, convenient drains, and accessibility to the tubes.

The amount of cooling surface required is generally based on the quantity of "free air" compressed per minute. As the thermal condition of the air subject to compression is dependent on the final pressure, it is evident that the amount of cooling surface in relation to

the free air capacity of the compressor varies with the discharge pressure. Theoretically,, the cooler should have a sufficient amount of cooling surface to reduce the temperature of the air between the two stages to the same point at which it was first taken into the low-pressure air cylinder. In practical working conditions, however, it will be found that the majority of coolers fail to accomplish this result, and a reduction to within 5 or 10 degrees of the original is usually conceded to be good practice.

An efficient water circulation is a matter which requires some thought and consideration, as the water is the agent which absorbs the heat units. The flow of the water should be through unrestricted pipes at such a velocity that the maximum number of thermal units is absorbed and carried away by the water. The best practice is to make the general flow of the water opposite to that of the air; the hottest air will then come in contact with that portion of the tubes containing the warmest water, and as the air in gradually cooled it comes in contact with the cooler portion of the cooling nest. In the intercooler shown in Fig. 1, the water circulates the entire length of the cooling nest four times. Entering through the lower pipe attached to the outside water head, the water being deflected by the partitions in the heads, circulates as indicated by the arrows shown on the small pipes. This circulation system is in accordance with the laws of thermo-dynamics; the hot water gradually finds its way to a higher level until it is finally discharged through the upper pipe leading from the outside water head.

It is good practice to make the cooler of such cross-section as to readily admit a free passage of the air after the "baffle plates" have been placed; and then, having determined this area, make the cooler of such length as is required to obtain the necessary amount of cooling surface. It is obvious that a cooler of large volume has advantages over one of smaller volume, even if the cooling surfaces be equal, because the air, in passing from the low to the high-pressure air cylinder, has a longer period of contact with the cooling tubes in the cooler which has the greater volume.

The compressed air should be well deflected in its course through the cooler. This result is obtained by placing several "baffle plates" in the cooler, as shown in the illustration, which deflect the air alternately towards each side, thus bringing the air into contact with all parts of the cooling nest.

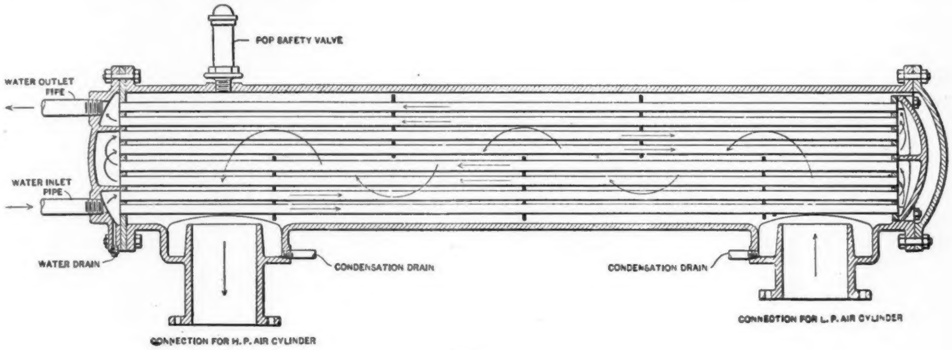


FIG. 1.

There are several small details of inter-cooler construction which should not be neglected, such as proper drains for drawing off the condensation of the air. The moisture of the air is in the form of a vapor, which when rapidly cooled, is condensed, and should be drawn off at stated intervals. Convenient drain connections should also be provided for draining the cooling nest in case of a suspension of the operation of the compressor at any time when freezing is liable to occur. It will be noticed that the cooler shown in Fig. 1 is so constructed that the entire nest of tubes can be withdrawn at any time for examination or cleaning purposes.

THE THEORY OF STAGE COMPRESSION WITH INTERCOOLING.

The theory of compound or stage compression is very readily understood. In the first paragraph of this article a statement was made

relating to the heat produced in the compression of air. For all pressures above 70 pounds per square inch, it is generally conceded that compound or stage compression should be employed. The heat of compression increases with the pressure; therefore, the higher the pressure the more difficult it is to reduce the temperature to a point enabling efficient compression conditions and proper lubrication of the air cylinders. In compressing air to 100 pounds terminal gage pressure in a single stage compressor, the final temperature of the air would be about 485 degrees F., as before mentioned. Some of this heat would be absorbed by the cylinder walls; yet the final temperature would remain too high to insure efficient compression conditions or proper lubrication. The adoption of stage compression with intercooling between the stages, although introduced some thirty to forty years ago, has been neglected by many compressor builders until within the last decade. At the present time stage compression is almost universally employed for all pressures above 70 pounds. unless the compressor is of such small size as to make compounding an uncommercial proposition.

In Fig. 2 is shown a theoretical combined indicator diagram from a two-stage compressor. In this diagram it is assumed that the compression follows the adiabatic curve in both high- and low-pressure cylinders with perfect intercooling between the two stages. The horizontal lines *A B* and *C D* represent respectively the volumes of the low- and the high-pressure air cylinders, drawn to the same scale. The vertical line *A C F* on this diagram will represent pressures to some designated scale. The adiabatic curve *B E K* represents the relation between pressure and volume for any position of the piston, assuming that there is no intercooler employed and that no heat radiates through the cylinder walls. In other words, this curve is the one which compression would theoretically follow in a single cylinder with no intercooling. In this curve the product $P\ V^{1.41}$* is constant, *P* and *V* representing pressure and volume respectively. On the other hand the isothermal curve *B D H* shows the relation between pressure and volume providing the temperature

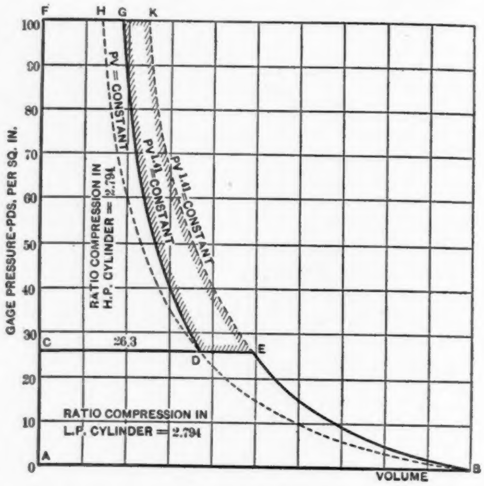


FIG. 2.

of the air under compression could be kept constant so that the product *P V* would also be constant.

Air taken into the low-pressure air cylinder at zero gage pressure, is compressed along the adiabatic curve *B E* until at the point *E* it attains a pressure of 26.3 pounds, equal to that of the intercooler, which allows the discharge valves to open and the air to pass into the cooler. In the intercooler the volume of a definite weight of the air is reduced from *C E* to *C D* so that the volume entering the high-pressure cylinder is less to the extent of *D E*, which is to the same scale as *C D* and *A B*. This means that the given weight of air represented by the volume *C E* at a gage pressure of 26.3 pounds, when cooled to the same temperature at which it was originally taken into the low-pressure air cylinder will be reduced in volume to *C D* providing the pressure of 26.3 pounds remains constant. The air taken into the high-pressure air cylinder at 26.3 pounds is compressed along the adiabatic curve *D G*. At the point *G* the high-pressure discharge valves open, and the air is discharged into the receiver at the desired gage pressure of 100 pounds. The shaded portion represents the power saving effected by the intercooler.

Assuming that a volume of 1,000 cubic feet of free air per minute is to be compressed to a gage pressure of 100 pounds with perfect intercooling between the stages, 153 horsepower is required. Compressing this same amount of

*The exponent 1.41 is the ratio between the specific heat of air at constant pressure and at constant volume.

air in the same time in a single stage requires an expenditure of 180 horsepower. This excess is equivalent to a saving of about 15 per cent. in two stage compression, which can be attributed directly to the intercooler. The actual saving, however, would fall somewhat below the above percentage, due to the fact that there are necessarily more frictional losses in the two stage machine than in one having a single cylinder; also the intercooler cannot be relied upon to reduce the temperature of the air between the stages to the normal in all cases. It is safe to state, however, that the saving in compressing to 100 pounds gage pressure would equal or exceed 10 per cent. in a well-designed compressor. At higher pressures, the saving in power is much more marked.

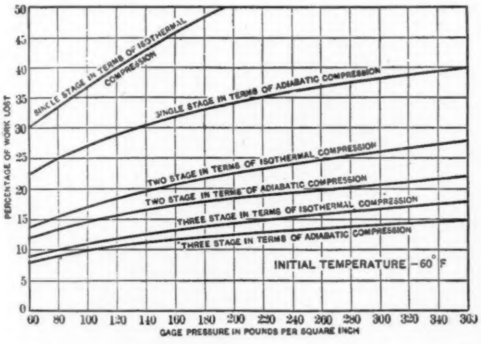


FIG. 3.

In Fig. 3, curves have been plotted which show the loss of work due to heat in compressing air to various pressures in one, two and three stages, assuming an initial temperature of 60 degrees F. in all cylinders, which is equivalent to perfect intercooling in the curves for stage compression.

As previously stated, the intercooler is primarily the medium on which the principle of compound compression is based, yet the saving due to the reduction in temperature between the stages does not constitute all the advantages of stage compression. The maximum temperature in each cylinder is reduced to a point where the heat can be more thoroughly drawn off by the water jackets surrounding the cylinder walls; also, the lower temperature in the cylinders is less liable to affect a good oil, thus insuring good lubrication of the pistons, valves, etc., with easier running conditions, less wear and longer life.

INCREASED VOLUMETRIC EFFICIENCY.

The volumetric efficiency of a compound compressor is obviously greater than that of one having a single cylinder. The compressed air remaining in the clearance space of the low-pressure cylinder, being at a much lower pressure, requires less movement of the piston on the return stroke before the air in the clearance space is expanded to a pressure equal to that of the surrounding atmosphere, which permits an opening of the air inlet valve. As free air is taken into the low pressure cylinder only, the high-pressure cylinder bears no relation to volumetric efficiency. The reduced temperature conditions in the low-pressure cylinder also causes less heating of the intake air when it comes in contact with the cylinder heads and walls, which results in obtaining a denser volume of air at each stroke of the piston, with a corresponding increase of volumetric capacity.

In addition to the advantages already mentioned, the maximum stresses in a compound compressor are reduced to about 55 per cent. of what they would be in a single stage machine compressing to the same pressure. In a single stage compressor having a cylinder of 20 inches diameter compressing to 100 pounds terminal gage pressure, the piston starts against no load and at the end of the stroke meets a maximum resistance of 31,416 pounds. Assuming the compressor to be running at a speed of 150 revolutions per minute, the piston meets this resistance and its release 300 times every minute. On the other hand, a two stage machine compressing to this same pressure with the intake or low-pressure cylinder of the same size as the above-mentioned single stage cylinder, would encounter a maximum pressure of only 9,424 pounds when working against a cooler pressure of approximately 30 pounds. In order to divide the load equally, the high-pressure piston area would be proportioned to the low-pressure piston area in the same ratio as the square roots of their absolute pressures. That is

High pressure area : 314.16 : : $\sqrt{14.7}$: $\sqrt{114.7}$.
Or high-pressure area=112.5 square inches.

The area 112.5 square inches is equivalent to a high-pressure cylinder diameter of about 12 inches. Compressing from 30 to 100 pounds in the high-pressure cylinder gives a maximum unbalanced pressure of 70 pounds, which is equal to a maximum load of 7,917 pounds to

be met in this cylinder. The total maximum resistance in both high- and low-pressure cylinders, is therefore, 9,424 pounds plus 7,917 pounds, or 17,341 pounds, which is only about 55 per cent. of that in the single stage compressor.

CARE AND USE OF AIR DRILLS AND HAMMERS

BY JAMES H. MAGUIRE.

Since the introduction of air tools much has been said for their economy in some cases and their expense in others. But although they may be expensive to buy, and in some cases expensive to maintain, in large erecting establishments they have become indispensable.

As to their use, you can have one hundred men on a floor and under certain conditions get along with five drills and nobody will ever be waiting, and on the other hand, you can have eight or ten drills on the same job and still have a lot of hand drilling to do.

Just put your head to work and look around. You see jobs that some men are doing where they use a drill about four hours a day and when finished they put it on the floor, somewhere, so that even they, when wanting it later, may not know where to find it; others desiring to use a drill and not knowing just where to get one, may lose considerable time in searching. Another class of men, when through with a drill or hammer, will hide it or lock it up so as to be able to get it when they need it again. Either way is wrong. Some common place should be selected to keep the drills and hammers; a large pan on which to lay them so that the oil will not run on the floor, and pegs of about 4 or 5 inches in diameter arranged to hang the hose on. When not in use hose should never be left lying around on the floor where trucks and castings may injure it. When a man wishes to use a drill he goes to the pan and selects the one required for his work. He will find there a key for the chucks and a hose. If there are no drills there, the noise from where they are running, or the sight of the hose, if they are piped from above, attracts him to where the drills are in use. When through using the drill he returns it, together with the key and hose to the common keeping place, so that the next man that wants it may know just where to find it. Don't let every man who uses a drill try to repair it; he loses time and frequently spoils it. Have a man who is schooled in the mechanism of the various machines to look after the repairs and forbid others to touch them.

In choosing a hammer, care must be taken to get one just right for your work, if possible. Don't get one that has too strong a blow, any more than you would get one that would not be strong enough to accomplish the work desired of it. If the hammer is used, say, for snagging castings, and the blow delivered knocks off the snags, and then has some kick beyond, you are tiring your operator unnecessarily. A very neat and handy way to help a man using a hammer is to make a sling suspended from his shoulder to help him hold the hammer; it helps wonderfully.

A word about the use of drills. As it very often happens, it takes a much shorter time to drill a hole with an air drill than it takes to fasten the drill to the desired place. So look to your tackle and see that the brackets used to hold the drills can be not only applied firmly but quickly, and train your men to handle them with the least possible outlay of energy and time. Don't install air drills, hammers, lifts, etc., and then not make it pay.

OILING PNEUMATIC TOOLS.

We now come to the most important item in the care of air tools—the oiling. As to the kind of oil, it is yet, to my mind, an open question. My best results have been with sewing-machine oil. Some of the manufacturers tell you to "use one-half pint of good oil every day in this machine." You can live up to that and still not have your machine properly oiled, and you can get along with one-quarter of that oil and have your machine oiled as it should be. Most machines have a hole or several holes marked "oil here." Oil in those places, of course. One of these holes is always in the crank case. After pouring in a quantity of oil let the drill stand in an upright position for a half a minute or so to let the oil run into the gear case, or whatever mechanism may be in the lower part of the machine, meanwhile turning the chuck so the oil may work into the gearing; then tip the machine upside down and let it stand for another half a

minute to let the oil work into the upper part of the machine; now pour out nearly all the oil that will run out of oil hole in the crank case, and if you find you have to pour out too much, put less oil in next day, until you have arrived at exactly the amount required to oil your machine thoroughly and leave a little in the case for the cranks to dash into the cylinders. No need of putting in a lot more oil than you need and then blow it out through your exhaust. Don't forget the following: pour just a little oil into the hole where your air enters so as to oil the valves. Some people recommend keeping the hammers in an oil bath when not in use. I get excellent results from mine by oiling four times a day with sewing-machine oil, and soaking them in a bath of benzine once a week. Drills should also be cleaned once a week with benzine. Now, the oil you pour out from your machines which, by the way, should be but little, as good oil of the kind described is expensive, you should save and run through a filter, not to be used again in the air tools, but to be used to oil shafting, etc.

In conclusion a few rules:

Until you are sure you have some better lubricant, use sewing-machine oil.

Oil drills once a day.

Oil hammers four times a day.

Clean both once a week with benzine.

Don't let every Tom, Dick and Harry try to repair your machines.

Get the most out of your equipment by having proper brackets and rigs, and when your machines and hose are not in use have them so anyone requiring them will know where to get them, and have them brought to this keeping place every night so that the man appointed to oil them will have his work done before the machines are needed for use in the morning.

You will find yourself amply repaid for any little trouble you may be put to, to organize some method of care and use of these valuable tools.—*American Machinist.*

Another steamship has been raised by the Arbuckle compressed air method. This time the vessel was the "Soperga," an Italian ship which went ashore on Molasses Reef on her way from New York to Galveston. The apparatus was applied April 29th, and on May 6th the vessel was afloat.

STORAGE OF COMPRESSED ACETYLENE

Ever since illuminating gas came into gener use, attempts have been made to compress it into portable steel cylinders or flasks for use on vehicles, and for country residences. The results obtained, however, were unsatisfactory, for illuminating gas is generally a mixture of many different gases, some of which easily liquefy under pressure while others, like methane, hydrogen, etc., can be liquefied only at very low temperatures. When these cylinders are connected up for use, the gas fed to the burner will vary greatly as to its heating and illuminating properties. Then there is always a certain part, generally as much as ten per cent., that will not volatilize but remains as a tarry deposit in the cylinder. Theoretically, acetylene is admirably adapted for this purpose, for it is homogeneous in its composition, leaves no deposit in the cylinder, and when properly fed to a suitable burner it gives an intense brilliant white light which is superior in many ways to any other form of illuminant.

The introduction of acetylene for lighting and other industrial purposes, is of rather recent date. Prior to 1895, this gas was scarely known outside chemical laboratories, but the discovery of calcium carbide and the process of making it, made this gas available for commercial use. Acetylene belongs to the class of unsaturated hydrocarbons and is unstable except at moderate pressures and temperatures. Its critical temperature is 37 deg. C., and pressure 68 atmospheres; however, it may be liquefied by a pressure of 21.53 atmospheres if the temperature is reduced to 0 degrees, and one cubic foot of this liquid would produce 400 cubic feet of gaseous acetylene at atmospheric pressure. If acetylene could be safely compressed and stored in steel cylinders in this cheap and simple manner, its use to-day would be much more general than it is, but liquid acetylene at normal temperatures is about as touchy as fulminate of mercury, and its disruptive power equal to that of nitroglycerine. Early attempts to handle acetylene in this form were fraught with numerous violent explosions. Usually it was impossible to discover the primary cause of the explosion, for the witnesses rarely ever survived the disaster, but it is probable that it was due to heat generated in manipulating

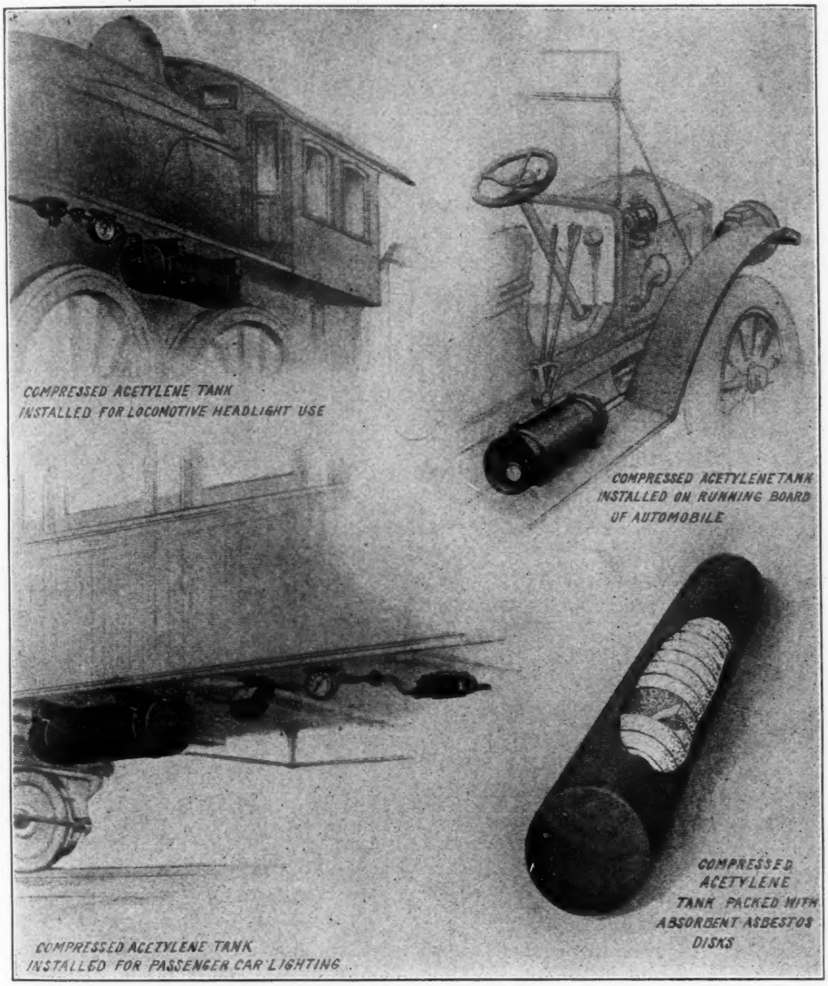
the outlet valve or to some blow on the cylinder.

Acetylene under a pressure of less than two atmospheres or thirty pounds per square inch is practically safe against explosion. Should the gas be brought in contact with a wire at white heat or should a priming of fulminate of mercury be exploded in the cylinder of gas at this pressure, the gas in immediate contact with the wire of fulminate will be decomposed, but the explosion would not be transmitted to the whole mass. When under greater pressure, an explosion caused by heat or concussion at one point, is instantly transmitted through the whole mass, causing a violent explosion. If the gas is in the liquid form, the pressure generated is enormous amounting to 5,000 or 6,000 atmospheres.

In exploding, acetylene disintegrates and hydrogen is set free, and usually takes fire as it comes in contact with the air, while the carbon is thrown down in the form of an extremely fine impalpable powder. It is possible that carbon obtained in this manner, called "acetylene black" by Hubou, may yet replace lamp black for delicate work. It has a pure black cast or tint, is free from grease, and is especially suited for making black paint, printer's ink and for printing calico.

About 1897, Georges Claude, of liquid air fame, and another Frenchman, M. A. Hess, discovered that acetone, a combustible liquid resembling wood alcohol, would readily absorb acetylene gas. In putting this discovery in practical use, they partially filled the cylinder with acetone and then forced the gas in under a pressure of about twelve atmospheres. At this pressure and at ordinary temperature, the acetone will absorb about 300 times its own volume of the gas. When the valve is opened the pressure is reduced and the surplus gas passes off to the point of use, such as a burner, leaving the acetone unaltered and capable of taking up a fresh charge of gas. In all cases where acetone is used, the valve must be kept at the top to prevent its escape. No trouble, however, would result should it get mixed with the gas, since it itself is inflammable. The gas stored in this way is safe against explosion so long as the cylinder is full, but this process is open to one serious objection. Acetone increases in volume when it absorbs the gas. A cylinder having only forty-seven per cent. of its volume filled with acetone at the beginning will be entirely filled with liquid when fully charged with the gas, and when the gas is escaping it shrinks, so that a cylinder which has been in use for some time will have a space at the top filled with gas under a dangerous pressure. Under a pressure of ten atmospheres (150 pounds) the presence of the acetone is an element of safety, for the acetylene dissolved therein does not explode, but should the pressure be over twenty atmospheres (300 pounds) it does explode and adds its heat of combustion to that evolved by the acetylene. While this process greatly reduced the chances of explosion, still the use of acetone alone was too dangerous to make the process a commercial success.

A few years later, Edmund Fouché, of Paris, added the final element which made compressed acetylene a commercial possibility. He first placed in the cylinder a filler of some inert porous substance, such as asbestos, infusorial earth, or charcoal, etc., and then added the acetone in which the gas was absorbed as before. In this way he prevented the existence of any considerable volume of compressed gas at any one point. In the illustration is shown one form or filler now in use. It consists of disks of asbestos entirely filling the cylinder. This filler decreases the gas holding capacity about twenty per cent., but its addition renders the gas entirely safe against explosion. In practice, these cylinders charged under ten atmospheres will hold about 100 volumes of the gas measured at atmospheric pressure. A platinum wire passing through the cylinder and heated electrically to a white heat has no other effect than to decompose the gas in immediate contact with it, for the porous filler effectually prevents the further spread of the explosive wave. The porous filler alone, when composed of charcoal, forms a perfectly safe medium for the storage of the compressed gas if the pressure does not exceed seven atmospheres. At this pressure, according to Capelle, a cylinder of one liter capacity will hold eight to nine liters of acetylene measured at atmospheric pressure. This is a cheap method and may be used advantageously where a large reserve supply is not needed. When the cylinders are exhausted they are usually sent to some central charging station. Here acetylene from the generator, after being purified, is com-



COMPRESSED ACETYLENE GAS STORAGE.

pressed generally in two stages, carefully cooled and then forced into large storage tanks which also contain a porous filler and acetone. The exhausted cylinders are connected up and charged directly from these tanks.

The consumption of compressed acetylene has become enormous in recent years. Small portable generators are not practicable in winter, as the water is apt to freeze, but the solution of acetone and acetylene will not freeze during the coldest weather. To-day no automobile is considered complete without a cylinder of acetylene for lighting purposes. The cylinders are also extensively used in lighting railway cars, boats, buildings, and for oxy-acetylene flame apparatus. As yet they are used but to a limited extent on locomotives for supplying the head lights, but this field may widen in future, for the light produced by acetylene comes nearer to being the same as sunlight than any other forms of artificial illuminant, and hence does not distort or alter the colors of the various signals used in railway work.—*Scientific American.*

The loss of power in a gas engine owing to its installation at considerable elevations above sea level may be roughly estimated at about $3\frac{1}{3}$ per cent. for each thousand feet. The decrease in barometric height is about one inch for 950 feet of altitude.

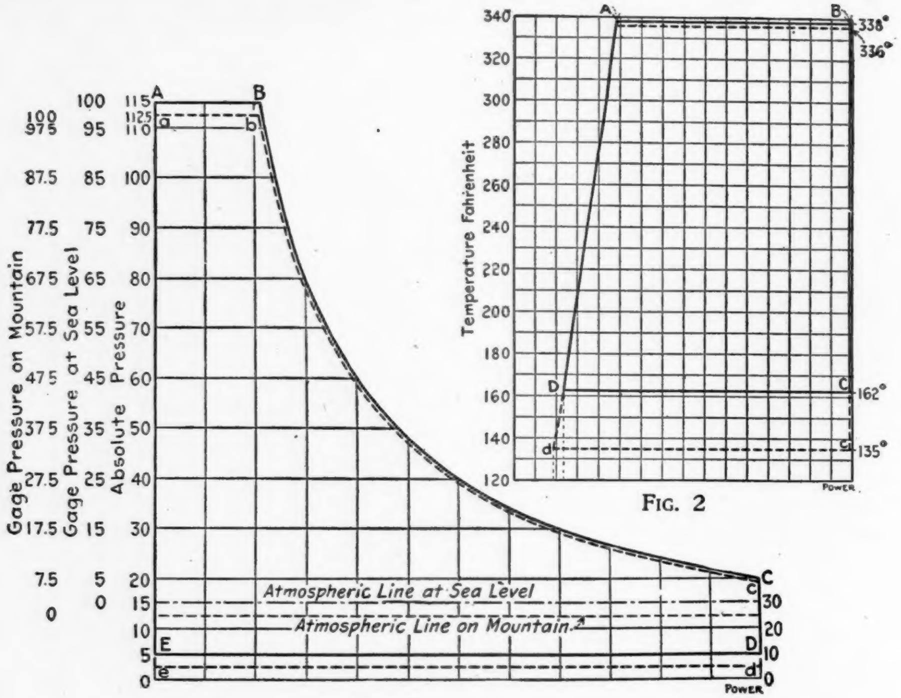


FIG. 2

FIG. 1

THE EFFECT OF VACUUM AT AN ALTITUDE

In a recent issue of *Power* the question was asked: "At a height of a mile is the vacuum in an engine cylinder as effective as at the sea level?"

And answered: "It is."

In an effort to be laconic the editor who wrote the answer failed to put himself into the mental attitude of the man who wrote the question. If the question asked no more than whether a given force is just as effective to move a piston in Colorado as in New York his answer is right, but the question is not worth answering. Adding twenty inches of vacuum will add, in round numbers, ten pounds to the mean effective pressure, and this wherever the engine may be, but this is too obvious to be taken as the point in the question. The atmospheric line from which it is reckoned has slipped downward at the higher altitude.

Suppose an engine with an initial pressure of 100 pounds gage and a vacuum of 20 inches to be run, first with a 30-inch barometer, as there might be at the sea level, and then with a 25-inch barometer, as there might be at the altitude of a mile. To simplify the matter, since we are not after absolute results, assume 2 inches of mercury to be equal to one pound pressure.

Then at the sea level with the 30-inch barometer the atmospheric pressure would be 15 pounds and the absolute initial pressure 115 pounds per square inch.

With a 20-inch vacuum the absolute back pressure in the cylinder would be 30 — 20 = 10 inches of mercury, or 5 pounds.

The ideal diagram would be *A B C D E* of Fig. 1, which, with a ratio of expansion of 6, gives a theoretical mean effective pressure of 48.5 pounds.

On the mountain, with the 25-inch barometer the atmospheric pressure would be 12.5 and the absolute initial pressure 112.5 pounds. With a 20-inch vacuum the back pressure in the cylinder would be 25 — 20 = 5 inches of mercury, or 2.5 pounds absolute.

The ideal diagram would be *a b c d e,* represented by the dotted lines, and, with six expansions as before, would give a mean effective pressure of 49.8 pounds; 2.7 per cent. more than in the case of the same engine with the same initial pressure (gage) and the same vacuum at the sea level.

The effect of the condenser is to reduce the

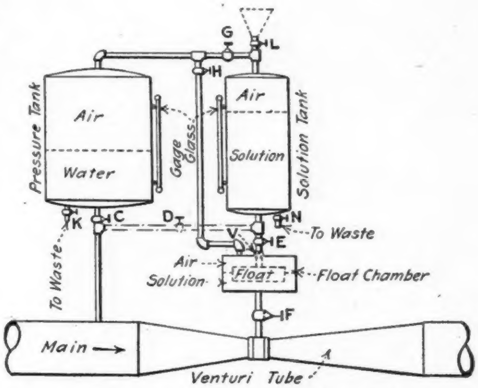
lower temperature level, to increase the head or fall of the heat between the temperatures of entry and rejection. A 20-inch vacuum on a mountain means a lower absolute pressure and a lower temperature of rejection than does the same vacuum at the sea level.

In the diagram, Fig. 2, heights represent temperatures instead of pressures, as they do in Fig. 1, but the area represents energy just as does the area of the other diagram. The diagram should be plotted with absolute temperatures, so that its real base is $460 + 338 = 798$ units below the level *A B* and the area of the whole diagram would represent the energy in the form of heat which must be put into a pound of water to make it into a pound of dry saturated steam at the given pressure. The area *A B C D* shows how much of this heat a perfect engine, working in a Rankine cycle between the limits 338 and 162 degrees (100 pounds initial and 20 inches vacuum at 30-inch barometer), could convert into mechanical energy as against that convertible by a similar engine working between the limits 336 and 135 degrees (100 pounds initial and 20 inches vacuum with 25-inch barometer), as shown by the area bounded by the dotted lines.—*Power.*

APPLYING CHEMICALS TO WATER IN PIPES UNDER PRESSURE

The modern tendency toward the use of hypochlorite and other disinfectants in the purification of water-supplies for drinking purposes has brought up the question of the most suitable means of applying these chemicals to the water.

To avoid contact with the pump valves, the solution can be added after the water has left the pumps; but the introduction of a definite proportion of some chemical solution into water flowing in a pipe under pressure is not an easy matter. The solution can be fed into the main readily enough by subjecting it to a pressure slightly exceeding the water pressure at the point where the feed pipe is attached, and the amount of solution introduced during any interval of time will depend on the difference between the feed pressure and the pressure in the main. The trouble is that the rate of flow through the main continually changes, so that the requirements are not met by simply maintaining the feed pressure at a definite amount above that in the main. The pressure differ-



A Device for Adding Hypochlorite or Other Disinfectants to Water in Pipes Under Pressure.

ence could be adjusted to give the right mixture at the average rate of flow; but with diminishing flow through the main the water would be over-dosed, and under-dosed when the flow increased above the average.

The problem has been met by the Simplex Valve & Meter Co., of 112 North Broad St., Philadelphia, Pa., by utilizing the well-known relationship between pressure drop and rate of flow in a Venturi tube.

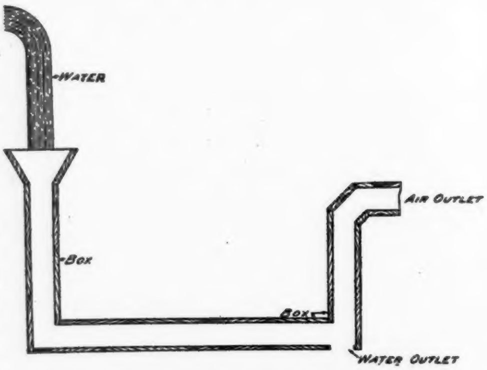
The ingenious arrangement of the apparatus is shown diagrammatically in the accompanying illustration. The chief elements are the pressure tank, the solution tank and the float chamber. Solution is admitted to the float chamber from the solution tank through a needle valve V. This valve is controlled by a float which keeps the solution in the chamber at a constant level. The pipes shown by solid lines in the diagram are the only ones in use when the apparatus is feeding solution into the main. A pipe from the main just above the Venturi tube opens into the bottom of the pressure tank. Water rises in this pipe and compresses the air above it in the pressure tank until the pressure in the main is balanced. A pipe from the top of the pressure tank communicates with the upper end of the solution tank, and a branch from this same pipe opens into the float chamber. In this way, the same air pressure as exists in the pressure tank is made to act on the contents of the solution tank and the float chamber.

The proportion of solution fed into the water in the main is regulated by adjusting the gate valve F. By observing the rate at which the solution level drops in the gage glass on

the solution tank and comparing it with the volume of water flowing in a given time through the Venturi tube, the proportion of solution being added can be definitely determined. When the valve F is once set at the correct opening, the solution will continue to flow at the desired ratio of grains per gallon regardless of variations in the amount of water flowing. This is because the pressure drop through the valve F is always practically the same as the difference in head at the full and contracted sections of the Venturi tube, which varies in direct proportion to the volume of water passing through.

The pressure on the solution in the float chamber will be slightly less than that in the main, due to the head of water in the pressure tank. This pressure difference would be of no consequence so long as it were constant, since it would be compensated in the adjustment of the feed valve F. As a matter of fact, however, the water in the pressure tank will rise while the solution is being drawn off from the solution tank. The amount of this rise will depend on the ration between the diameter of the pressure tank and the capacity of the solution tank. If the capacity of the solution tank be made, say, 130 gals., the rise of water can ordinarily be reduced to a fraction of one per cent. of the total head on the main by making the pressure tank 4 or 5 ft. in diameter. The effect on the solution feed will then be negligible.

As the solution is drawn off from the solution tank, the water rises in the pressure tank until finally when all the solution has been drawn off an equivalent volume of water will have been admitted to the pressure tank. The solution tank will meantime have received the same volume of compressed air. This air can be returned to the pressure tank by closing valves C and E and opening valves D and K. This causes water from the main to pass into the bottom of the solution tank and drive the air before it back into the pressure tank. The water in the pressure tank is driven out by the air and escapes through the drain valve K. The solution tank is next cut off from the main and from the pressure tank by closing valves G and D, and can then be emptied of water through the drain valve N. A fresh charge of solution is then poured in through the funnel shown by dotted lines, and everything is ready to begin feeding again as soon as the valves G, E and C are reopened.—*Engineering News.*



EARLY IRON MANUFACTURE AND A PRIMITIVE BLOWER

At a recent meeting of the Engineer's Society of Western Pennsylvania, when methods of iron and steel manufacture were under discussion, Mr. Jas. H. Baker said: In the matter of iron making it may interest my young friends to have a description of what I saw in this line 53 years ago in the mountains of Virginia. I would take my father's team and go to an iron works and wait all day while the forge made for us probably a ton of wrought iron from the pig. I am not an illustrator, but the accompanying rough sketch will show you how we obtained the blast to blow the open hearth fire in which the pig iron was melted down, refined, forged into a bloom, reheated and forged into bar iron. A fall of water of say 15 ft. was secured, and after falling some four or five feet to acquire velocity it entered an upright box or hollow log, the lower end of which was inserted in a horizontal box, and at the opposite end of this last and on the lower side was a hole to let the water out, while the air carried in all the falling water escaped from the top of the box through another vertical log or box and was carried to the forge. The hammer was run by tups fastened in the wooden shaft of an overshot water wheel, while the spring to give the hammer force was made of dry hickory wood. There were only two sizes of iron given out to iron wagons with, and from these we made all the small forgings as well as the large ones.

It takes 4.221 pounds of ore, 2,310 pounds of coke, which means about three thousand pounds of coal, and 1,147 pounds of limestone, a total of over four tons of ore, coal, and limestone, to make a ton of pig iron.

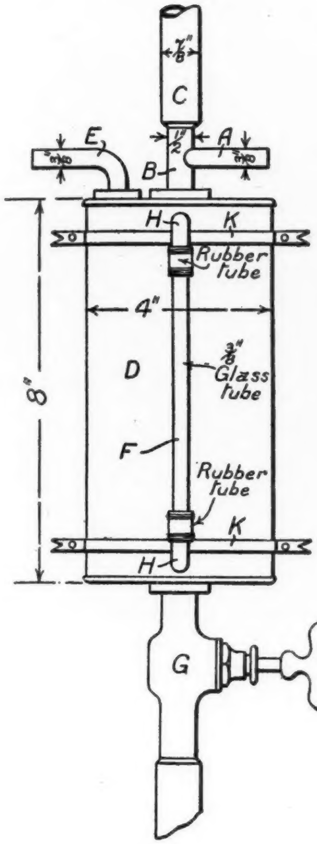


FIG. 1.

A WATER OPERATED LABORATORY BLOWER

By R. J. England.

A very simple substitute for the usual bellows in connection with a blowlamp, etc., is shown in Fig. 1. Where a water main at fairly high pressure is available, this apparatus supplies a constant blast of air to the lamp at a pressure equal to that given by a good foot bellows, and the advantage of being able to give all one's attention to the work in hand is obviously very great.

The arrangement consists of a closed cylindrical vessel D of dimensions shown in Fig. 1, which is preferably made of brass, having a T piece fixed at the top. One end of limb B of the T piece is connected to the supply pipe C, while the other end communicates with the vessel D, the limb A being left open. A pipe E, also connected with the interior of D, is led from the top, and connected to the blowlamp, etc., by rubber tube. A water gauge F is fitted to D to enable the level of the water to be read, while G is the exhaust pipe, which must have a stop cock, as shown.

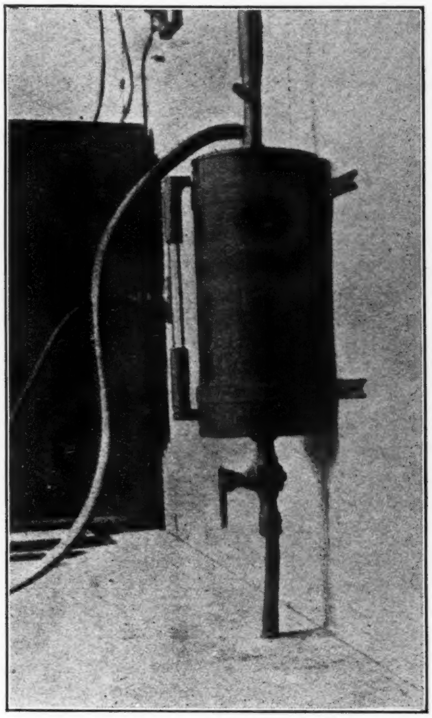


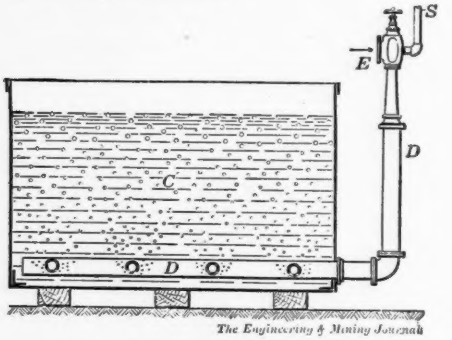
FIG. 2.

The action of the above apparatus is very simple. When connection is made with the main, water at a high pressure in the pipe C enters the T piece with a large velocity, the pressure energy of the water being here almost altogether changed to kinetic energy, the pressure in B falls below that of the atmosphere, and hence air rushes in through A, and mixing with the water, is carried into D. Now the stop cock on the exhaust pipe is so regulated that there is always a few inches of water in the lower part of D. It will be seen that the air which has been carried into D has now no way of escape except by the pipe E, so if this is closed the pressure in D must rise. Hence we can get a constant supply of air from the pipe E. A blower of the dimensions shown is in daily use in a large physics laboratory for sealing tubes and for glass work generally.

The vessel D is made of sheet brass with

soldered joints, while the water gage is simply made by soldering in two ⅜ in. right-angle gas bends, as shown, and connecting the free ends to a piece of straight glass tube by means of rubber tube. The whole apparatus is fixed to the wall by two strips of metal KK, and is permanently connected up to the water main through a stop cock.

The above apparatus may be used also for drawing air through tubes, etc. Thus, suppose we wish to fill an optical instrument with dry air, to prevent condensation of moisture on the glasses in cold weather, all that is necessary is to connect one end of the instrument to be desiccated to drying tubes, etc., and the other end to limb A of the T piece on the blower. When the water is turned on a steady stream of air will be drawn through the drying tubes into the instrument. For this purpose the tube E and the stop cock G should be left full open. Of course, if it is only required for the latter purpose the T piece A B is alone required, and the rest of the blower may be dispensed with.



AIR-JET AGITATOR

DIRECT STEAM-COMPRESSED AIR FOR SLIME AGITATION

By Oekar Nagel.

Air compressors are generally used in the cyanide process for supplying the aëration necessary according to the equation:

$$2Au+4KCN+O+H_2O=2KAu(CN)_2+2KOH$$

If, without any extra expense the air for this reaction could be furnished by means of an appliance in which direct steam is the acting medium, it would mean a great advantage as compared to the present process, since the aëration would be coupled with a simultaneous costless heating of the solution. The effect of heating is important in the cyanide process, as it means an acceleration of the reaction and more rapid solution (Nernst has shown that in nearly all reactions the speed is doubled by a 10-deg. C. increase in temperature).

An apparatus suited for sucking or pressing air by means of steam through liquids is the steam-jet exhauster, shown in the accompanying illustration. *D* is the discharge, *E* the gas and *S* the steam entrance.

Compared with air pumps, these instruments have advantages which give them the preference wherever they are applicable, viz: (1) They have no moving parts and need practically no repairs; (2) the cost of the jet apparatus is only a fifth that of air pumps; (3) the jet apparatus may be simply inserted in the pipe line, while air pumps, as a rule, require foundations, and often separate buildings. These steam-jet exhausters are constructed for a mean steam pressure of 45 lb., and are built with capacities from 100 to 60,000 cu. ft. per hour.—*Engineering and Mining Journal.*

MARBLE

The word "marble" is not an exact scientific term, but merely a popular or trade designation for certain kinds of limestones. No definition can be made broad enough to include all of the marbles, or restricted enough to exclude certain limestones. The accepted definition is: "A crystalline limestone, capable of taking a high polish, and suitable for use in building or decoration." But some structural marbles are highly crystalline and yet take only a dull polish. There are limestones, on the contrary, that will take a polish and yet cannot be called marbles because of their lack of a crystalline texture. Lithographic limestone can be polished, but no one would think of calling it a marble because of its dullness and lack of distinction. Most of the foreign limestones that we are now using for interior decoration partake far more in their structure and texture of the nature of lithographic stone than of genuine marble. But because of their beauty in coloring and the soft polish they take, they are now very largely classified as marble by the trade.

The longest word found in the Imperial edition of Webster's dictionary contains 13 syllables and 27 letters—one more than the alphabet numbers—"perineocalporectomyomectomy," which names a delicate and complex operation in surgery.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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CONTENTS

FOR HIGH PRESSURE GAS

Compressed air and compressed gas, whether natural gas compressed by the forces of nature, or manufactured illuminating gas artificially compressed, are so closely related that it would seem not to be going out of the way to speak of the latter in a journal ostensibly devoted to the interests of the former, as is done in our present issue. The air compressor is of course quite as readily a gas compressor also, and for it to be offering, and indeed urging the acceptance of, its services for gas as well as for air should be natural enough. Indeed the compressor has a right to feel slighted while its proffered services are so ignored and the gas interests give it so little employment.

Experience has completely demonstrated, especially in European practice, that gas served at higher pressures is more economical and satisfactory for the consumer, and many miles of high pressure distributing pipes have been laid and are in satisfactory use in cities both in England and in Germany. The pressures now desirable where the gas is to be used are of course impossible at the gas holders of the present type, and such holders when required for the storage of inert gas, to compensate for the varying rates of consumption, should be permissible to any capacity that may be required at or near the point of gas manufacture, but there can be no necessity for locating such gas holders in valuable sections of crowded cities, entailing such enormous depreciations of neighborhood properties. Natural gas practice everywhere would seem to completely upset any claim that the gas holder is a nuisance which is unavoidable.

QUARRYING BY AIR AND BY ELECTRICITY

The work of the rock channeler is simple enough in the essential idea of it—just cutting slits in bed-rock normally vertically downward and extending considerable lengths horizontally, but also working at all angles, from the vertical to the horizontal. The facility with which it does this special line of work has made the machine of the greatest importance, and now it is indispensable to the quarryman for getting out stone according to requirements, and to the engineer for securing smooth sides to rock-cut canals and aqueducts.

Few of our industrial operations can enum-

erate so many important collateral advantages resulting without some offsetting considerations. Not only is the element of chance eliminated in the size and shape of stones produced, so that they require a minimum of work for the ultimate dressing and finishing, but at the quarry the waste to be disposed of is reduced to the smallest possible amount, and the condition of the bed is as good as, or better than, before for subsequent operations.

The channeler being accepted as a necessary detail of the equipment of the up-to-date quarry, the most important consideration in connection with it is as to the drive of it. In this the channeler is not to be considered alone, but in connection with the entire power equipment and the requirements of all the apparatus employed, to which it should be able to accommodate itself without sacrifice of efficiency.

The first channelers were steam-operated, generally having their own boilers and enabling the machines to be located and operated in locations otherwise not practicable. This, however, could not long satisfy the developing conditions. The pushing habit of electricity has brought it to the quarry also, and it has become very desirable in many cases, on account of the out-of-the-way location of the work or the large water-power available at a convenient distance, to employ the electric current for all power requirements.

This has hitherto been impossible on account of the rock drills and the channelers, which have insistently required either steam or air. The most persistent experimenting and the most ingenious inventing and designing have not brought a successful electrically driven rock drill in sight, and, the operating conditions of the channeler as to power application being identical, it has been in the same category.

Following only tradition and habit, without any persistent attempt at simplification, it might easily have happened, and in some cases it did happen, that steam and air and electricity were all used in the same plant for different details of the work. If one medium could have been employed for all of the power transmitted instead of the three, the presumptive economy and convenience should be self-evident. Of the three, the one which now most strenuously refuses to be dispensed with is electricity, and in many cases the sooner it is adopted the better.

So far as the rock drill and the channeler are concerned, they have entirely ceased to embarrass one in the employment of electricity for driving. If electric current is the most available, the most economical, or in any way the most desirable power to be used in any given case, and if all the other apparatus can properly be electrically driven, then the electric drive is the best also for the drills and channelers. The electric-air principle as employed in both of these adapts them perfectly to the electric drive, not only without the slightest sacrifice of efficiency or convenience, but with a very appreciable and demonstrable saving of power for every unit employed. The electric-air drive, so far as the essential operating principle of it is concerned, was not a gradual or step-by-step development. It is one of those inventions which *came all at once,* bringing all its advantages with it, some of them only revealed by actual experience after the event. The saving of power was certainly not the first thing thought of in the first installations of the electric-air drill and channeler, but none of their advantages are more pronounced and indisputable.

NEW BOOK

Power, by Charles E. Lucke, Ph.D. New York Columbia University Press, 324 pages 7¾ by 5¼ inches, 223 illustrations, $1.50 *net.*

Although this is a series of "Hewitt" lectures delivered at Columbia University, it does not pose as a learned book and it would seem to be better adapted for the general public than for the student. It gives a very complete and an easily readable account of all the sources of mechanical power and of the means employed to make these available for industrial purposes, and it is not cumbered with mathematics or too minute details which are already sufficiently accessible.

ELECTRIC ROCK DRILL EXPERIENCE

The following occurs in a paper on "The Tietton Canal" by E. G. Hopson, Transactious of American Society of Civil Engineers, March, 1911.

The third long tunnel, the Trail Creek Tunnel, was driven for almost its entire length through an unusually hard blue basalt. The driving was effected at first by electric drills operated by three-phase, 60-cycle, 220-volt alternating current. As the work progressed,

continual trouble was caused by breakage of parts of these drills, the springs operating the rebound being particularly susceptible to injury. Duplicate parts could only be obtained after much delay. In addition, there was much difficulty on account of labor, it being found practically impossible to obtain drillmen skilled in the use of electric drills. Ordinary drillmen would generally refuse to use the apparatus, or, if persuaded to make a trial, would obviously use it in an unsympathetic and ineffective way. Careful study, however, of the effectiveness of the electric drills, even when skillfully handled, showed that in very hard rock they were uneconomical, their penetrative power being low. Eventually, Temple-Ingersoll Electric-Air drills were substituted, and the work was completed with them. These drills are practically air drills driven by an electrically-operated air pump on a small truck. This apparatus was found to be much more effective than the electric drills for which they had been substituted, the blows being much more forcible and the penetration correspondingly more economical. This apparatus, moreover, was found to be far less subject to injury than the electric drills.

AUTOMATIC CONTROL OF ATMOSPHERIC HUMIDITY

By Charles Mandeville.

Allied to the thermostatic system is that of the humidistat, or the controlling of the moisture, which has been widely applied in connection with our most modern systems for heating and ventilating.

When indirect heating is used, where air is drawn over tempering coils and forced through ducts to delivery points, the air delivered is often very dry, so dry as to be injurious to our lungs.

Air at any ordinary temperature contains moisture in the form of vapor, the amount depending upon the temperature of the air, not in direct proportion but in increased proportion. Water in the air is necessary both for the growth of animal and of vegetable life. The human body is constantly giving off moisture from the skin and lungs and this process is very important to the preservation of a healthy bodily condition.

Now that we have settled that air which is very dry or that contains a low percentage of moisture will produce bodily discomfort and eventually ill health, it has remained for our scientists to settle for us that a relative humidity of 60 or 70 per cent. is about the most comfortable for our living rooms. The humidity or dampness of the air does not depend alone upon the quantity of aqueous vapor present but upon the nearness to the saturation point. The moisture necessary to cause saturation increases rapidly with the temperature. Therefore the quantity of water that would saturate the air at a low temperature would only partly saturate it at a higher temperature. We say that the air is damp when it is nearly saturated with vapor.

Heating air, while the quantity of vapor remains unaltered, removes it farther from the saturation point and diminishes its dampness. When damp air from out doors passes through tempering coils it becomes dry air; not because it has lost any of its moisture, but because its capacity to take up water vapor has increased with the rise in temperature. The requisite amount of moisture is then much greater and it is necessary to add more water vapor to bring the rooms nearer to the saturation point. Humidity is therefore expressed relatively as the proportion of the water vapor present to the total amount required to saturate air at that temperature and pressure. If air containing water vapor be gradually cooled, a temperature will at length be reached at which the vapor will begin to condense. This point is called the dew point.

HUMIDISTAT SYSTEM.

Ventilating experts have put an extra coil of pipe in the heating chamber where our regular tempering coils are, just at the beginning of the ducts or passages leading to the rooms to be heated. This extra coil of pipe is put into a sheet iron pan. The pressure of the steam used in this extra coil is usually somewhat higher than that used in the tempering coils proper; it has been found good practice to carry about 20 lb. pressure in order to get the benefit of the additional heat units in the steam at higher pressure.

There is placed beside the pan holding the heating coil an ordinary plumber's cistern fitted as usual with a float valve or ball cock and piped to some water supply source. This cistern is set at such a height as to maintain

a constant level of water, enough to cover the steam coil in the humidistat pan, into which it discharges its water.

SIMILARITIES OF HUMIDISTAT AND THERMOSTAT.

In the room or duct where it is desired to maintain a uniform humidity of the air the humiditat is placed. This instrument is in construction and action identical with that of the thermostat except that while the small expansion strip of the thermostat is made of brass and steel, in the humidistat it is a piece of wood of a kind which is highly sensitive to the action of the moisture contained in the air surrounding it; sugar maple is commonly used.

HYGROMETER.

In order that we may know what the humidity of the air is, there must be provided an indicator or measuring instrument called a hygrometer. It consists of 2 thermometers arranged on a board with a scale or table of figures and lines between them. The bulb of one of the thermometers dips into a small trough which is kept filled with water. If the surrounding air is not saturated, evaporation will occur from the wet bulb and the constant abstraction of heat will lower the temperature below that of the surroundings. After a little time the wet bulb will indicate a temperature constantly below that of the dry bulb by an amount depending upon the humidity, since the rate of evaporation is determined by the amount of water vapor present in the air. The scale on the board is made to show by means of a traveling pointer or movable arm just what humidity the thermometer readings show to be existing at the place where the instrument is set.

There is one feature to be noted in connection with this system: as heated air will hold more water than cooled air, if we heat the air supply and load it up with 75 or 80 per cent. of all the water it will take, we must be careful to avoid lowering its temperature, either on the way to the point of delivery or at the delivery point itself, otherwise excessive condensation will occur.

In operating this system it is necessary to arrange so that the steam supply to the humidistat coil is not controlled by the automatic valve until the heated air has been circulated for some little time, say 15 min., and that the steam supply is shut off from the automatic valve before the tempered air supply is shut off. This regulation of steam delivery is done by a hand-controlled valve placed on the reduced pressure steam pipe behind the automatic air-controlled valve controlled by the humidistat. Notice here that this is an essential feature in the operation of this system and must especially be attended to where the heated air is forced through ducts or passages by mechanical blowers or fans.

In connection with the compressed air supply there has been an arrangement made to guard against this danger of excessive humidity. In the ordinary action of the compressed air controlling valve in both thermostatic and humidistatic systems, when the air goes on the diaphragm valve the valve shuts. In case a pipe should break in this system or should the compressor fail to keep up the required pressure, the entire system of control valves should remain wide open. Now while in a system of thermostatic control of heating alone this condition can be tolerated in such an emergency, in the case of the humididistatic system there is a difference. Should the automatically-actuated steam supply valve to the coil in the moistening pan remain open the water supply to the pan is automatically maintained and the steam coil would get all the water it could boil and would boil all it could get. In a short time there would be clouds of steam going through the air passages and condensing in the rooms supplied.

In order to prevent such an accident there has been arranged for this system the scheme of putting 2 air-controlled valves in the reduced-pressure steam line supplying the coils in the humidistat pan, one valve being immediately behind the other. One valve is so connected that the steam pressure is underneath the valve seat, so that when the air supply is cut off from the diaphagm valve the pressure of the steam forces the valve open. This is the ordinary action of these valves. The other valve is piped so that the pressure comes on top of the disk, when the air pressure acts to hold it constantly open against the steam pressure. The air line to this second or emergency valve is taken directly from the main air coming from the receiver and is not controlled by an instrument, hence in case the main line pressure fails the valve will be shut by the steam pressure, aided by the spring around the valve stem.

NOTES

The only two foods which contain all the substances necessary to human life are said to be milk and the yolk of eggs. A man can live in health on these two foods.

The highest waves ever met with in the ocean are said to be those off the Cape of Good Hope. Under the influence of a northwesterly gale they have been known to exceed 40 feet in height.

Demonstrations that gasoline can be profitably extracted from natural gas have been made in Ohio, West Virginia and Pennsylvania, where a number of plants have been installed. It is reported that a large plant is soon to be established in Kern county, California, where it is expected to handle 4,000,000 cu. ft. of gas daily, and make a yield of 8,000 gallons of gasoline per day.

A plant for extracting nitrogen from the air electrically for use as fertilizer is in course of construction near Great Falls, S. D. The first installation will have a capacity of 5,000 horsepower at a pressure of 6,600 volts. If the first installation proves a success additional equipment will be added to the plant later to bring the capacity up to 25,000 horsepower. No details of the process are available at present, but it is reported that the nitrogen is extracted by means of large electrical furnaces and absorbed by means of crushed limestone.

It is said that a height of 7.5 miles is the highest point at which a recorded temperature was ever secured. This height was reached by a balloon sent up from the meteorological laboratory of Toronto, Feb. 3. When the instruments sent up with the balloon were recovered, it was shown that the balloon burst at 7.5 miles and that the temperature was 90 degrees below zero.

In a new form of milking machine just invented by a Swedish engineer, pressure instead of suction is employed, so that the act of milking is similar to that of the hand operation. The device consists of a set of rubber-covered plates which are made to press the teats by means of suitable mechanism driven by a small electric motor. The current required to drive the machine is less than half an ampere.

Discovery of oil at Carlyle, Illinois, has increased the respect in which oil-men have held the work of the State Geological Survey. Leases were taken and wells drilled on the strength of the structure as shown in Bulletin 16, and a new field brought in. Mr. F. W. DeWolf, Mr. R. S. Blatchley, and their associates, are to be congratulated on this quick proof of their good work.

A cement for making tight joints in pumps, pipes, etc., is made of a mixture of 15 parts slaked lime, 20 parts graphite, and 30 parts barium sulphate. The ingredients are powdered, well mixed together, and stirred up with 15 parts of boiled oil. A stiffer preparation can be made by increasing the proportions of graphite and barium sulphate to 30 and 40 parts respectively, and omitting the lime.

A borehole 7,347 ft. deep was put down at Czuchow in Silesia recently. Temperatue measurements at different depths showed an average temperature gradient of about 55 ft. per degree F., but near the middle this increased to 31 ft. per degree, while in the lower third the gradient was only 91 ft. per degree. The temperature near the bottom was 182 degrees F.

In modern industries peculiar conditions occur involving liability to fire where water is not only ineffective, but dangerous as an extinguisher, and the use of sand is among the substitutes. The new fire apparatus of a London electric lighting station is a truck holding 600 pounds of sand and carrying a fiber bucket and a couple of spades. This equipment is specially adapted for the purpose, and is advised for motor garages, oil stoves, electric theatres, etc.

On May 2 compressed air was for the first time turned on to the main hoist of the Mountain View Mine, Butte, Montana, formerly driven by steam. The engine has been reconstructed, with cylinders of increased capacity and other changes of details, and of course, as reported, "responded quickly and easily to its power." It is practically assured

that the Anaconda mines will soon be operated at a great saving by the new power arrangements.

The Trafalgar, British battleship, which cost $4,095,840 to build and equip in 1887 was sold at auction recently for $125,000, about 3 per cent. The Pique, a second-class cruiser went to a Dutch shipbreaking company for $57,500, and another, the Tribune, brought $52,500.

Meteorological reports from European Russia show that an anti-cyclone of unprecedented intensity prevailed over the eastern portion of that country on November 26th and 27th, 1910. At several stations the barometric pressure (reduced to sea level and standard gravity) exceeded 800 millimeters (31.50 inches). At Katharineburg, at 7 a. m., November 26th, the barometer (corrected and reduced as stated above) read 800.7 millimeters (31.524 inches), the highest pressure ever recorded at a European station.

The final ripening process in the preparation of California oranges for the market is the exposure of the fruit to steam vapor, which imparts the golden yellow color described on the labels by "sun-kissed" and other appetizing terms. In fact, however, electric heat is employed to a large extent in producing this steam vapor, electric immersion coils in open tanks of water in the ripening rooms producing the warm humidity required to give the final tint to the orange of commerce.

The president of a manufacturing company in the Middle West says he is not satisfied with the atmospheric conditions in which we are living, that we need more ozone for its directly beneficial results as well as for its purifying and disinfecting actions, and suggests the desirability of producing a commercial form of ozone generating apparatus that can be placed on the desk or bench of a worker and be coupled up and operated by the electrical current of an ordinary light or power supply.

President Kuhn, of the Pittsburg-Westmoreland Coal Co., has devised a simple method for lessening the dangers of explosions, particularly dust explosions, on cold winter days, when the danger from this source is greatest. When the temperature is low the moisture in a mine is quickly absorbed by the ventilating current on account of the dryness of the air, and to overcome this feature Mr. Kuhn has exhaust steam turned into the fan houses at all his mines following a sudden drop of temperature. This keeps the air-currents moist and prevents the mines from becoming filled with dry dust. Other companies in Western Pennsylvania have adopted the plan.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MAY 2.

990,830. AIR-LIFT. MIKE P. BISCHOFF and JOHN W. REYNOLDS, Oilfields, Cal.

990,886. PUMP. WILLIAM J. LAPWORTH, Pittsburg, Kans.

1. In a pneumatic pump including a pump-cylinder having a water inlet port, a water discharge pipe, an air supply pipe and a relief port, the combination of a valve for said water inlet port, a valve for said air supply pipe and a valve for said relief port, and means operatively connecting the valve in the air supply pipe with the relief port valve, said means comprising a cylinder communicating with said discharge pipe, a float in said cylinder and connections between said float and said valves, whereby the movements of said float will close one of said valves and open the other, and automatically operative means connected with said air-supply pipe for admitting air directly to said discharge pipe.

990,897. FLYING-MACHINE. ABEL T. NEWBURY, Vermilion, Alberta, Canada.

990,944. THROTTLE CONTROL FOR FLUID-OPERATED HAMMERS. JACOB F. ZWIKER, Toledo, Ohio.

990,948. AIR-FORCING APPARATUS. CHARLES F. BAKER, Newton, Mass.

990,953. AUTOMATIC AIR-BRAKE APPLIANCE. JOSEPH SEWELL BAXTER, Millsap, Tex.

990,976. ENGINEER'S VALVE. ERNEST GONZENBACH, Greensboro, N. C.

991,040. PRESSURE-CONTROLLED OPERATING MEANS FOR TROLLEY-POLES. AYERS A. STRANGE and WILLIAM ANDERSON, Memphis, Tenn.

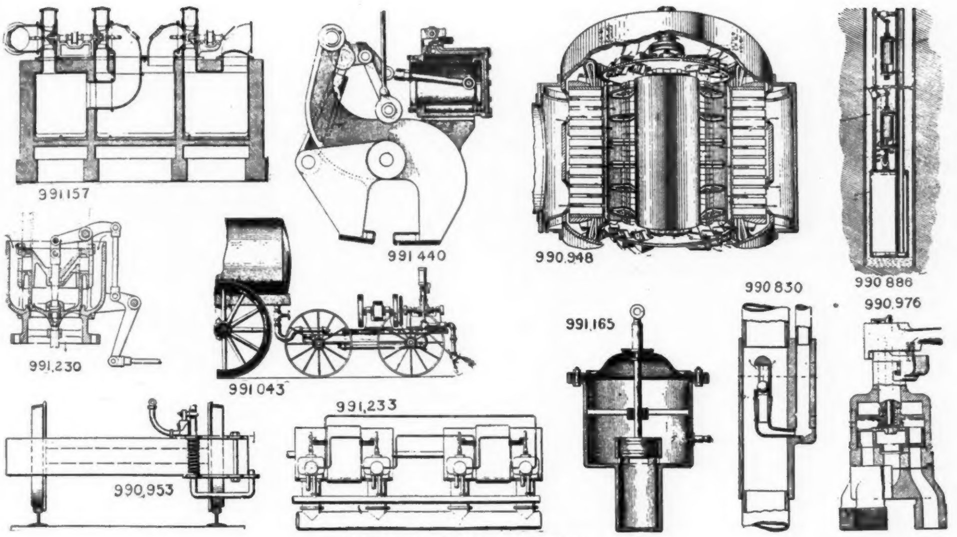
991,043. PROCESS OF MAKING ROADWAYS. JOSEPH E. WARD, Longbeach, Cal.

1. The process of making a roadway which consists in atomizing oil in contact with air, in such manner that the oil tends to remain suspended in the air for an appreciable time, bringing the atomized oil and air into contact with a porous road surface, causing the oil to permeate the the porous road surface while still in atomized condition, and causing the atomized oil to be deposited on the material of the road surface while said material is agitated and partly suspended.

991,115. FLYING-MACHINE. GEORGE S. UDSTAD, Aurora, Ill.

991,157. PROCESS OF WASHING GASES FOR RAPIDLY FREEING THEM FROM DUST OR SMOKE HELD IN SUSPENSION THEREIN. PAUL KESTNER, Lille, France.

991,165. PNEUMATIC VEHICLE-SPRING. FRANK W. MILLS, Chicago, Ill.



PNEUMATIC PATENTS MAY 2.

991,223. COMPOSITION OF MATTER. FRANK MLEKUSH, Rankin, Pa.

991,230. OVERBALANCED FLUID-PRESSURE VALVE. EDWARD P. NOYES, Winchester, Mass.

991,233. STARTING DEVICE FOR GAS-ENGINES. GUSTAV BERNHARD PETSCHE, Philadelphia, Pa.

991,440. FLUID-PRESSURE RIVETING-MACHINE. ELMER ELSWORTH HANA, Evanston, Ill.; Philetus W. Gates, conservator.

991,459. GAS-ENVELOP FOR AIRSHIPS. JOHN C. SCHLEICHER, Mount Vernon, N. Y.

MAY 9.

991,493. MERCURY VACUUM-PUMP. HENRY ALBERT FLEUSS, Thatcham, England.

991,500. AIR-BRAKE SYSTEM. FRANK GOFF, Camden, N. J.

991,504. SHIP'S-TELEGRAPH RECORDER. EDWARD A. HENKLE, Philadelphia, Pa.

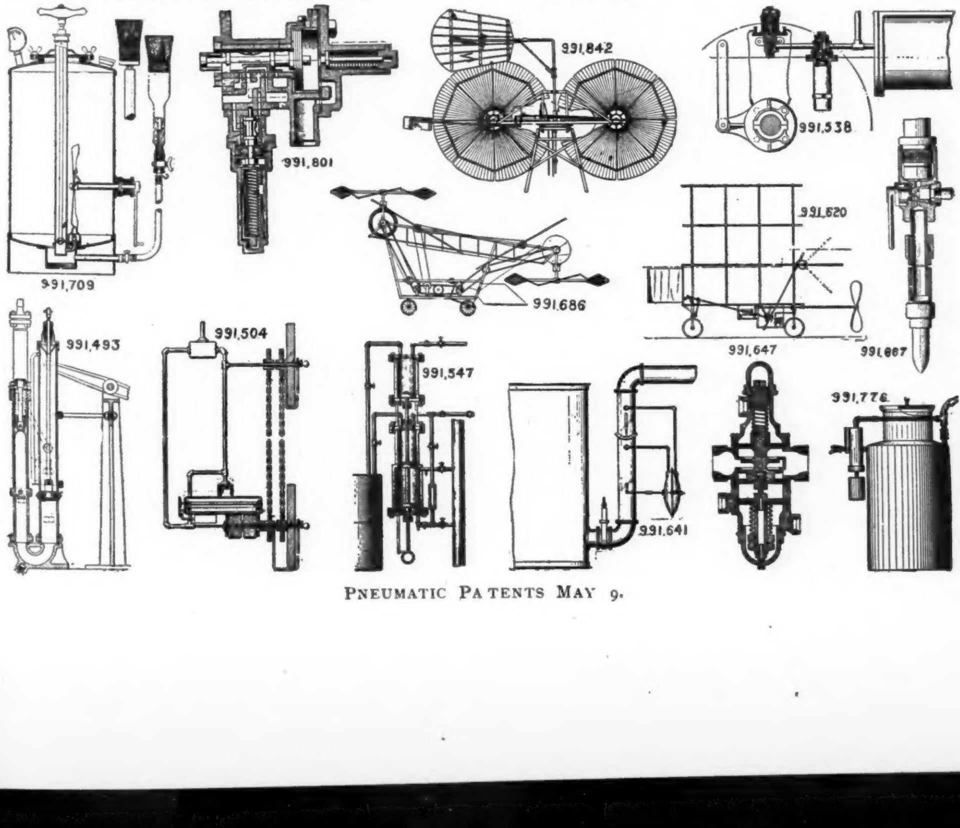
991,528. AERIAL NAVIGATION. JACK LLOYD NICHOLS, Belton, Tex.

991,530. AIR-VALVE. CHARLES E. NORMAN, Chicago, Ill.

991,538. FLUID-PRESSURE BRAKE. WALTER PHILLIPS, London, England.

991,547. DUPLEX FORCE-FEED LUBRICATOR. ALBERT E. SCHAD, Bellefonte, Pa.

991,568. APPARATUS FOR COOLING AND DISPENSING LIQUIDS. WILLIAM H. WALTER, Chicago, Ill.



PNEUMATIC PATENTS MAY 9.

991,572. AIR-FILTER. SIMON P. WEISENSTEIN, Sharpsburg, Pa.

991,620. AEROPLANE. JOHN HUGHES, Baker, Mont.

991,641. DEVICE FOR CONTROLLING FLUIDS. PIERCE PLANTINGA, Cleveland, Ohio.

991,647. AIR-PUMP GOVERNOR. DANIEL W. RIDINGER, Defiance, Ohio.

991,667. HAMMER-DRILL. ALBERT H. TAYLOR, Easton, Pa.

991,686. APPARATUS FOR AERIAL NAVIGATION. JEAN M. ALLEAS, Boston, Mass.

991,699. FLUID-PRESSURE ENGINE. GEORGE CASSADY, New Westminster, British, Columbia, Canada.

991,709. PAINTING APPARATUS. GEORG HEINRICH FISCHER, Neustadt-on-the-Hardt, Germany.

991,718. PNEUMATIC PIANO-ACTION. AXEL G. GULBRANSEN, Chicago, Ill.

991,776. MILK-CAN ATTACHMENT FOR MILKING APPARATUS. EZRA E. GOOD, Waterloo, Iowa.

1. In a milking apparatus, the combination with a can, of a milk conduit leading into said can, an air suction conduit leading from said can, a by-passage connecting said air suction conduit to said milk conduit independently of said can, and a suction controlled valve mechanism arranged to open and close said milk conduit and by-passage in alternate order and to hold said milk conduit closed at all times when said by-passage is open, substantially as described.

991,801. FLUID-PRESSURE BRAKE APPARATUS. JOSEPH REICHMANN, Chicago, Ill.

991,842. WINDMILL. ALBERT F. GEORGE, Enid, Okla.

991,851. CONTROLLING - BELLOWS FOR PNEUMATIC MUSICAL INSTRUMENTS. JOSEPH P. HULDER, New York, N. Y.

991,902. AIR-PUMP. JOHN SCHLOSSER, Wilmington, Del., and ANDREW W. CHRISTIAN, Philadelphia, Pa.

991,932. AIR PURIFIER AND SEPARATOR. DAVID BASHORE and JOHN E. SHAVELAND, Walla, Walla, Wash.

991,989. ATMOSPHERIC ENGINE. ANTON HOLM, Passaic, N. J.

992,039. RADIATOR AIR-VALVE. ARTHUR O'BRIEN, Butte, Mont.

MAY 16.

992,144. BLAST-NOZZLE. FRED A. BABCOCK, Wyndmoor, Pa.

992,147. TERMINAL FOR PNEUMATIC-TUBE APPARATUS. LOUIS G. BARTLETT, Somerville, Mass.

992,156. WELDING-TORCH. HARRY BROUSSEAU, New York, N. Y.

992,204. AIR BLOWING OR COMPRESSING APPARATUS. JOSEPH E. JOHNSON, Jr., Ashland, Wis.

1. In combination, a steam engine actuating a positive compressor, a turbine driven by the engine's exhaust and actuating a centrifugal blower, and a connection from the blower's discharge to the compressor's intake.

992,214. ELECTROPNEUMATIC BRAKE. LOUIS ALFRED LARIVIERE, Paris, France.

992,223. PNEUMATIC-DESPATCH-TUBE APPARATUS. JAMES G. MACLAREN, Harrison, N. Y.

992,238. AIR-DISTRIBUTER FOR PNEUMATIC MILKING-MACHINES. ERIK ARVID NILSSON, Hornsberg, Stockholm, Sweden.

992,260. VAPORIZER AND SEPARATOR. CHARLES A. RUSH, San Francisco, Cal.

992,279. PRESSURE-OPERATED GAS LIGHTING AND EXTINGUISHING APPARATUS. ERNEST SPARKS, London, England.

992,295. DRYING OF NON-PULVERULENT MATERIALS. FRITZ TIEMANN, Berlin, Germany.

992,320. APPARATUS FOR DRYING DOUGH AND PASTRY GOODS. OTTO WIRZ, Cannstatt, Germany.

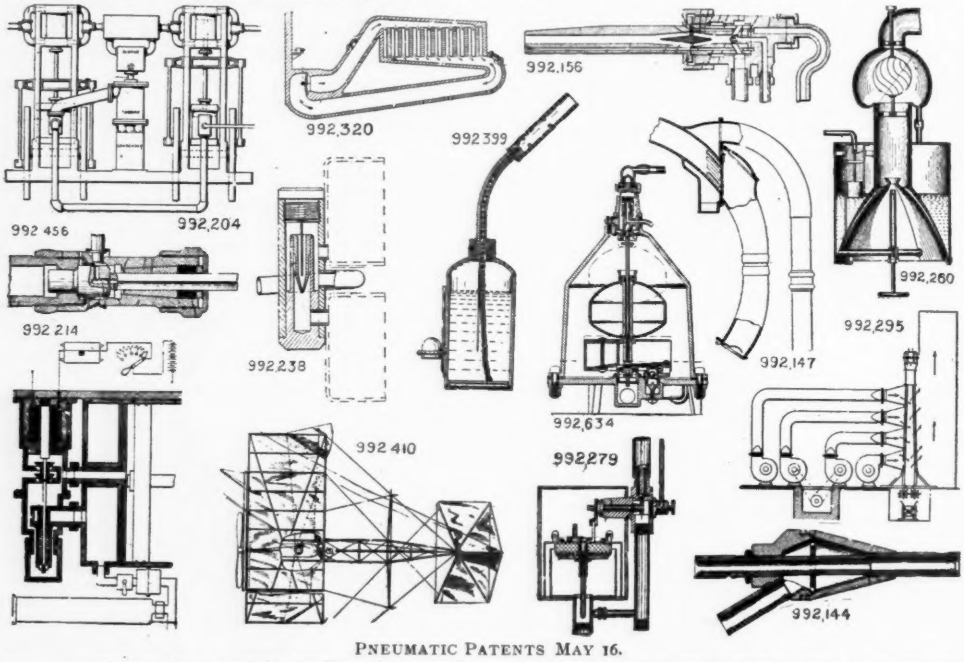
992,364. VACUUM CLEANING APPARATUS. JAMES W. LEASURE, Bradford, Pa.

992,399. AUTOMATIC PRESSURE-TORCH. OTTO BERNZ, Newark, N. J.

992,410. AERODROME. EDWARD J. ELSAS, Kansas City, Mo.

992,456. HAMMER-DRILL. ALBERT H. TAYLOR Easton, Pa.

992,483. PNEUMATIC VIBRATION-DIFFUSER. CHARLES H. COX, Los Angeles, Cal.



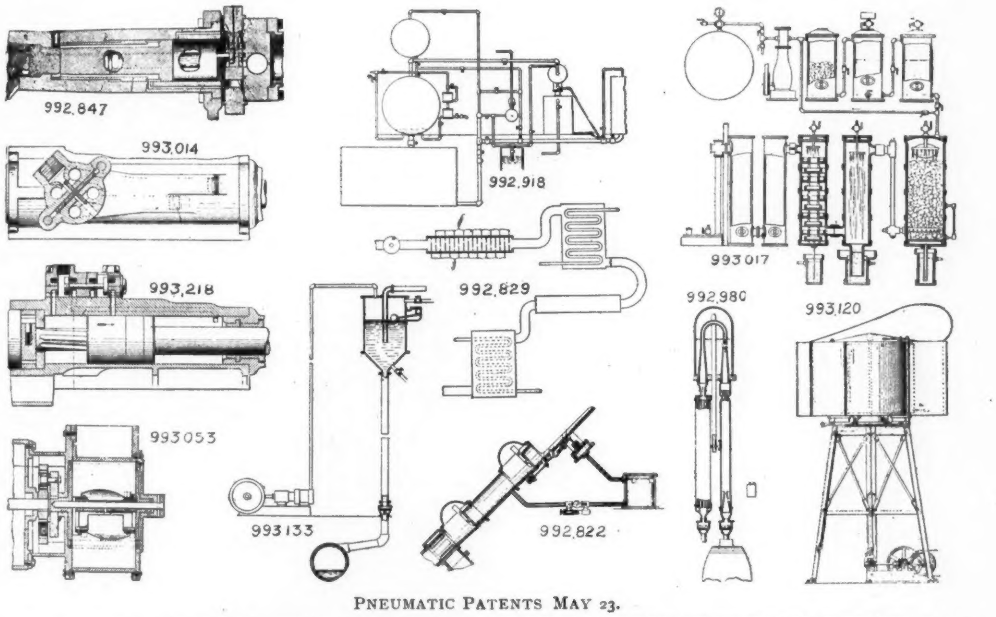
PNEUMATIC PATENTS MAY 16.

992,564. AIR-BRAKE SYSTEM. GEORGE L. ICKES, Newport, Pa.
992,634. AIR-COMPRESSOR. HARRY E. BAILEY, Albany, N. Y.
992,726. FLYING-MACHINE. EDWIN LYMAN MADDEN, Ingersoll, Okla.

MAY 23.

992,784. VALE FOR PNEUMATIC-DESPATCH-TUBE APPARATUS. ISAAC W. LITCHFIELD, Boston, Mass.
992,822. PNEUMATIC-DESPATCH-TUBE-APPARATUS. CHARLES F. STODDARD, Boston, Mass.
992,824. VENTILATING MECHANISM. BERNARD A. STOWE, Cleveland, Ohio.
992,829. PROCESS OF DESICCATING AIR. HERBERT T. WESTON, Cleveland, Ohio.
992,847. DRILL. WALTER E. CARR, Telluride, Colo.
992,849. FRESH-AIR-INLET-DEVICE. JOSEPH CHALKE, New York, N. Y.
992,918. PROCESS OF IMPREGNATING WOOD. CHARLES STOWELL SMITH, Berkeley, Cal.

within the inner tube, and a second electrode formed of a coil of wire, said coil being wound spirally upon the outer tube.
993,014. VALVE-MOTION FOR ROCK-DRILLS. LEWIS C. BAYLES, Johannesburg.
993,017. APPARATUS FOR OBTAINING NITROGEN FROM AIR. CHARLES BLAGRURN, San Francisco, Cal.
1. An apparatus for obtaining nitrogen from atmospheric air consisting of a furnace of considerable area in proportion to its height to expose a large body of sulfur to oxidation and so concentrated as to compel the whole of the air supplied to said sulfur to flow into contact with the sulfur in the furnace, means for supplying sulfur and air at one end of said furnace, a conduit at the other end of said furnace for the resulting gases, means for removing from said gases the sublimated sulfur, means for washing from said gases the sulfurous acid, and means for confining the residual nitrogen, substantially as described.
993,038. CONTROLLING DEVICE FOR PNEUMATICALLY-OPERATED MOTORS. THOMAS DANQUARD and WILLIAM J. KEELEY, New York, N. Y.



PNEUMATIC PATENTS MAY 23.

2. The herein described process of preserving wood which consists in introducing the wood into an air tight cylinder, subjecting the wood in said cylinder to the action of the bath of oil at approximately 220 degrees F. for a length of time sufficient to heat up the wood and thereby vaporize most of the water contained in the wood, then drawing off the oil and applying an air pressure of about 50 pounds per square inch, introducing a preservative oil at approximately 120 degrees F. and raising the pressure to about 157 pounds per square inch, for a length of time sufficient to insure the desired impregnation, then relieving the pressure and simultaneously drawing off the unabsorbed oil and then subjecting the wood to a vacuum for the purpose of drawing out a portion of the oil from the cell cavities.
992,932. ENGINE-DRIVEN COMPRESSOR. GEORGE L. BADGER, Quincy, Mass.
992,980. OZONE-PRODUCING APPARATUS. OCTAVE PATIN, Paris, France.
1. An ozone apparatus comprising two concentrically positioned tubes having an annular space space therebetween, an electrode positioned

993,053. SUCTION-PRODUCING DEVICE. JOHN H. GOEHST and JOHN A. DUNLAP, Chicago, Ill.
993,063. AERODROME. ROBERT ERNEST HEATH, Yorkville, S. C.
993,108. AIRSHIP. THOMAS RHOADES, Hanna, Utah.
993,120. WINDMILL. CLEMENT A. STERNER, Allentown, Pa.
993,133. DUST-COLLECTOR FOR PNEUMATIC CLEANING SYSTEMS. DAVID T. WILLIAMS, Paterson, N. J.
993,202. VACUUM-CLEANER FOR CARPETS AND THE LIKE. JOHN H. RUSSELL and ALBERT A. CARSON, Ashland, Ohio.
993,218. VALVE-MOTION FOR ROCK-DRILLS. LEWIS C. BAYLES, Johannesburg, Transvaal.

MAY 30.

993,343. DUST-COLLECTOR. PERCY D. BREWSTER, East Orange, N. J.
1. A dust collector having a pipe adapted to carry the air and dust, means for introducing

water into the air and dust while under the partial vacuum, means for producing the vacuum and separate means adapted to remove the water from under the partial vacuum.

993,356. AIR-COMPRESSOR FOR USE WITH ENGINES. FRANK E. FOLLETT, Otterbein, Ind.

3. The combination of an engine cylinder, a hollow stud projecting from the end wall thereof, an air pump adapted to be moved longitudinally into position on said stud, means for locking said cylinder in position on the stud, a reciprocatory plunger disposed within said cylinder and plunger rod secured to said plunger and extending through said stud into the interior of the engine cylinder in position to be engaged and actuated by the engine piston located therein, substantially as described.

993,415. PNEUMATIC APPARATUS. JOSEPH SCHWERTNER, New York, N. Y.

993,424. THROTTLE-VALVE FOR ROCK-DRILLS. DANIEL S. WAUGH, Denver, Colo.

993,628. FEED-WATER REGULATOR. ORBERT E. WILLIAMS, Scranton, Pa.

3. The combination with the main feed line of a boiler, and an inlet valve therein, of a fluid pump communicating with the tank above the liquid therein for inducing a current of air to flow from the reflector into the tank.

993,648. ROTARY FLUID OPERATED AND OPERATING DEVICE. ALMON B. CALKINS, Passaic, N. J.

993,655. MEANS FOR INFLATING PNEUMATIC TIRES. HARRY L. CORSON, Dayton, Ohio.

993,659. PNEUMATIC WHEEL. OTTO P. DOWNING, Pecos, Tex.

993,694. VACUUM CLEANING APPARATUS. FRANCIS D. LARSON, Salt Lake City, Utah.

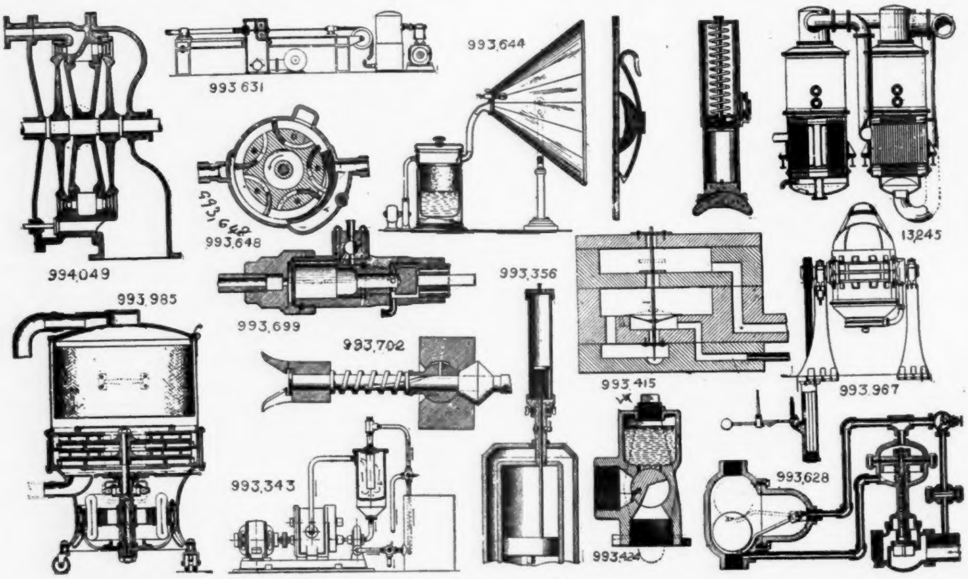
993,699. POWER-DRILL. DUNCAN LAREN McFARLANE, Victor, Colo.

993,702. AUTOMATIC AIR-COUPLING. H. STANLEY MILLER, Johnson City, Tenn.

993,724. AEROPLANE. OLIVER G. SIMMONS, Washington, D. C.

993,928. APPARATUS FOR FEEDING PULVERIZED FUEL. JOHN A. WELTON, Canal Dover, Ohio.

1. The combination with a fire box, of means for feeding comminuted fuel thereinto, comprising a fuel receptacle, a trough mounted in the



PNEUMATIC PATENTS MAY 30.

pressure device to operate said valve, acted on by fluid from a constantly flowing stream, and means operated by changes of water level in the boiler to restrict such stream of fluid to varying degrees.

993,631. METHOD OF MANUFACTURING HOLLOW METAL RODS, BARS, AND THE LIKE. ARTHUR YOUNG and THOMAS ROWLANDS, Sheffield, England.

1. The method of removing a refractory core from a hollow rod or bar which consists in discharging a jet of a gaseous fluid under pressure directly against the end of said core, and progressing said jet through said rod or bar as rapidly as said core is disintegrated by the action of said jet.

993,644. INSECT-DESTROYING APPARATUS. ARTHUR BRISBANE, New York, N. Y.

1. In an apparatus of the character described, the combination of a tank having therein a quantity of liquid as kerosene or the like, a removable container located in the liquid, a reflector, a pipe connecting the reflector with the tank above the liquid therein, means for illuminating the reflector, a suction pump and connections from the discharge end thereof, and spaced at its opposite edges from the walls thereof, a screw conveyer working in the trough, a cylindrical casing mounted beneath the trough and the discharge end of the receptacle, a grinder and conveyer mounted in said casing, a pipe into which the casing discharges, and a fluid pressure pipe leading to and discharging into the fire box, the said pipe being entered by the fuel pipe.

993,967. SAFETY OR BRAKING DEVICE FOR APPARATUS DRIVEN BY FLUIDS UNDER PRESSURE. JOSEPH HUBERT DEBAUCHE, Gilly, Belgium.

993,985. PNEUMATIC PUMPING-MACHINE. CHARLES EDWARD HARKER, Parnassus, Pa.

993,989. VACUUM SUPPORTING DEVICE. ROSS HAZELRIGG, Oakland, Cal.

994,049. FLUID-PRESSURE TURBINE. KARL ALQUIST, Rugby, England.

994,104. AIRSHIP. WILLIAM CHARLES HURST, New York, N. Y.

13,245. (Reissue). VACUMM EVAPORATOR OR HEATER. JOSEPH E. DUNN, Philadelphia, Pa.

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Chicago Pneumatic Tool Co.
Galigher Machinery Co.
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Pumps, Pneumatic Displacement.
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Galigher Machinery Co.
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Galigher Machinery Co.
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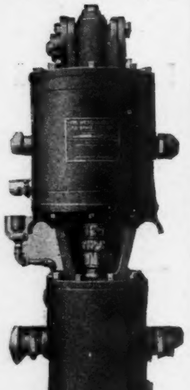

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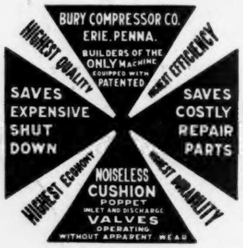

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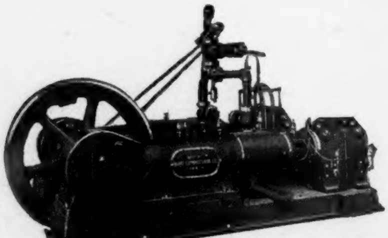

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